

February 22, 1960

Aviation Week

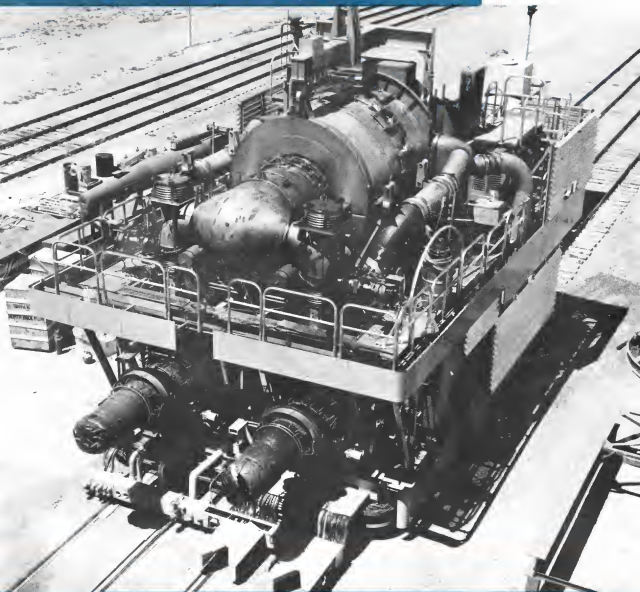
and *Space Technology*

75 Cents

A McGraw-Hill Publication

**Beech Speeds
Plans For
Turbine Planes**

**GE Jet Engine
Nuclear Reactor**



Industry Surveys Hydrofoil Field

CRYOGENIC TRANSFER PUMPS for every GSE need

Centrifugal pumps, developed and produced by our Turbomachinery Division, handle hydrogen, oxygen, nitrogen, fluorine, and fluorides. Standard designs are immediately available, or can be adapted to meet special requirements for pumping any and all rocket propellants.

- Low Net Positive Suction Head offers advantage of pumping from pressurized tanks, with significant large installation savings.
- Capacities from 50 to 5000 gpm
- Pressure rises from 50 to 5000 psi
- Light weight design, resulting in low backoff during system cooldown
- Leakproof sealing systems for safely handling hazardous fluids
- Variable-speed electric motor pump drive for varying pump output requirements

Aerjet-General
CORPORATION
Pumps, Valves and Fuel System Components



Engineers, Scientists—Send your engineering requirements of Aerjet



Hydro-Aire fuel booster pumps provide higher reliability, are lighter in weight, and cost less.

Still Another Hydro-Aire Product for the Aircraft and Missile Industries

The Hydro-Aire fuel booster pump shown above is typical of a universally accepted family of pumps—known around the world—*known around the world*. As used in jet fighters, bombers, and missiles, this pump is lighter—weighing only 6.8 pounds—is lower in cost, has proven much more reliable. It pumps 20,000 pounds of fuel per hour at 16 psig minimum. Ambient temperature range is —65°F to 250°F at sea level to 100,000 ft. altitude. These units consistently demonstrate excellent dry running, vapor and ice handling characteristics.

Attention: Fuel System Designers

Hydro-Aire can supply pumps, subassemblies or systems to handle Acetylene, JP fuel, water, alcohol, liquid nitrogen, liquid oxygen, hydraulic oil and engine oil. They can be supplied electric motor driven, hydraulic motor drive, engine driven or turbine driven.

Send your requirements or write for information.

Engineers: Interesting opportunities are available. Write or call Mr. Douglas Nykawa, Chief Engineer, 2000 Winona Avenue, Burbank.

*High vapor/liquid ratio

HYDRO-AIRE
PUMPS, VALVES AND
FUEL SYSTEM COMPONENTS

Available in 1000's of
designs and probably
of infinite variety—
well, certainly not the
one or two you might
think of. Write for a
free catalog.

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"GOOD WILL" is the disposition of
the pleased customer as regards to the
place where his business is treated
— D.F. Supreme Court

AVIATION CALENDAR

Mar. 7-19th Annual Bureau Aircraft
Safety Seminars. Dayton, Ohio. Dauntless
Spokane Flight Safety Foundation.
Mar. 9-18-Symposium on Surviving Vi-
cinity for Re-Echo Stations. Miami
Hotel Drexler, Clear Springs. Midland
Chapter. Society of Aircraft Material &
Process Engineers.
Mar. 9-10-Conference on the Mechanical
Properties of Engineering Composites.
North Carolina State College. Raleigh.
N. C. Symposium. North Carolina State
College School of Engineering Office of
Continuing Research, U. S. Army.
Mar. 16-17-National Flight Properties
Meeting. Island Hotel, Jamaica, at the
Accommodated Services, Cleveland.
Mar. 17-Helicopters as Load Carriers.
Capacity of Helicopters. American Society
of Mechanical Engineers. Lubbock. Tex.
Aviation Engineering Society Building in
Manhattan. New York, N. Y.
Mar. 15-Defense Planning Seminar. Edo-
mond Industries Assn. Hotel Hilton.
Hotel Washington. D. C.
Mar. 17-18-Aircraft Design and Testing
Symposium. Department of Commerce.
Aeronautics. Washington, D. C. Sympos-
ium Day. Bureau of Naval Weapons.
Mar. 22-24-Exercises of Radio Symposium.
International Commission. Wash. Nat-
ional and Columbia, New York, N. Y.
Mar. 22-23-Symposium on Optical Spectro-
scopy. Maintenance of High Tempera-
ture. University of Chicago. Chicago.
Ill. Spaceman University of Chicago. Ap-
plied Science Laboratories. Toward Hill.
Calif. National Science Foundation.
Mar. 21-23-General Support Equipment
Conference. American Rocket Society.
Radio Station. Harts. Detroit. Mich.
Mar. 24-25-First Annual Symposium on
Hazard Factors in Electronics. New York.
N. Y. Spaceman Institute of Radio En-
(Continued on page 6)

AVIATION WEEK and Space Technology February 22, 1962

Vol. 72, No. 2

AVIATION WEEK and Space Technology is a special section of AVIATION WEEK, the leading publication in the field of aviation and space technology. This section is published bi-weekly, on February 22 and August 13, 1962. It contains a wealth of information on the latest developments in aviation and space technology, including articles on the design and construction of aircraft, the development of new propulsion systems, and the latest advances in space exploration. The section is edited by a team of experts in the field, and is a must-read for anyone interested in aviation and space technology.

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SMI REPORTER

By STANLEY M. INDERGILL, *Executive Engineer*



Report No. 2 TS 539 Test Set

Our new TS 539 Test Set answers the demand for simple, fast and accurate means of flight line testing of air data computers and a general test device for the generation of accurate pneumatic pressures in a wide variety of applications. The critical sensing element within our TS 539 is an SMI force balance pressure transducer of extreme sensitivity and accuracy.

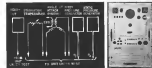
As two examples of widely different points in a typical flight envelope, the TS 539 generates inlet and static pressures to simulate an aircraft flying at Mach 6.8 at sea level to an accuracy of $\pm 1\%$ within element within our TS 539 is an SMI force balance pressure transducer of extreme sensitivity and accuracy.

The TS 539 also includes capability of simulating angle of attack and stagnation temperatures.

In the TS 539, a completely self contained Precision Dual Pressure Generating System supplies the necessary signals simulating the broadest range of flight conditions. Power functions are provided for most class of selected signals and pressure in mode for reading of other signals to a digital readout. Comprehensive tests may be accurately and quickly performed by non skilled operators. Automatic and manual control is provided to select outside which simulate conditions within a control flight envelope. Usability flexibility is inherent in the design that permits ready adaptation to any test requirement involving the need for precision control of pressure sources.

Typical Performance Specifications

Static Pressure, P_s	$\pm 1\%$ to 500 mm Hg
Dynamic Pressure, P_d	$\pm 1\%$ to 20 mm Hg
Total Pressure, P_t	$\pm 1\%$ to 120 mm Hg
Stagnation Pressure, P_{st}	$\pm 1\%$ to 200 mm Hg
Discharge Pressure, P_d	$\pm 1\%$ to 100 mm Hg
Angle of Attack, α	Full 360 degrees



What are your needs? If your requirements call for test equipment for accurate generation of simulated pressures, write or wire for complete information. Address your inquiries to Stanley M. Indergill, Executive Engineer.



SERVO MECHANISMS, INC.

Los Angeles Division
4000 Aviation Boulevard
Hawthorne, California



AIRBORNE BORE TEMP. CONTROL SYSTEM

Schematic diagram of Ramo-Wooldridge's bore temp. control system. The probe (1) is inserted into the fuel line. The control valve (2) regulates the fuel flow based on the temperature reading. The control unit (3) is powered by a 28VDC source.



Airborne electromechanical system regulates jet fuel temperature

An integral part of each main engine installation on the Martin P-602 Scavenger is an Airborne R-6000 bore temperature control system. By regulating air flow through a fuel solenoid, this system maintains supply line fuel at 100-220°F.

As developed for the P-602, the R-6000 system consists of a temperature probe, a control amplifier and a solenoid valve. The probe (mounted in an M21907-12 fitting) is in direct contact with the temperature-regulated fuel and provides to the control loop a resistance which is proportional to fuel temperature. In response, the control loop energizes the solenoid to change the setting of a fuel air intake valve, thus regulating volume of air flow through an air fuel heat exchanger. This sensing and response mechanism is a self-contained bore temperature control system.

is activated, at which point the system reaches a state of electrical balance.

A fail-safe feature is also provided. In the event of power failure, a magnetic clutch in the solenoid is released, permitting the air valve to be pulled open by the force of the turn air.

This application* as the P-602 illustrates only one of many possible adaptations of the Airborne R-6000 system for temperature control functions on aircraft, missiles and related equipment—cabin temperature control, engine temperature control, temperature regulation of fuel, oil, electronic cooling packages, etc. If you have requirements in these areas, we will be happy to make a proposal. Contact any of our offices.

*Detailed in detail in our Bulletin R-6000, available on request.

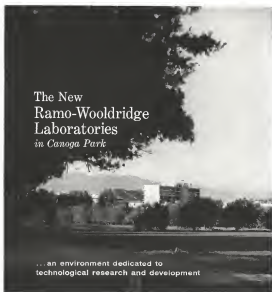


Engineered Equipment for Aircraft and Industry
AIRBORNE ACCESSORIES CORPORATION
 HILLSIDE 8, NEW JERSEY • Offices in Los Angeles and Wichita

AVIATION CALENDAR

(Continued from page 5)

- gives Professional Group on Human Factors in Electronics.
- Apr. 14-1967 National Aeronautics Meeting and Aviation and Aircraft Engineering Display Society of Automotive Engineers, Commodore Hotel, New York.
- Apr. 14-15-Bowling Drags of Space Vehicle Conference, Biltmore Hotel, Santa Monica, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.
- Apr. 15-1967 National Meeting "Upper Atmosphere-Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.
- Apr. 15-18-1967 Engineering in Space Technology (Hotel Rialto, Dallas, Tex.) Sponsor: American Institute of Electrical Engineers.
- Apr. 15-18-1967 Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Hotel Rialto, Cincinnati, Ohio.
- Apr. 15-20-International Symposium on Active Materials and Piezoelectric Systems, New York, N. Y. Sponsor: Polytechnic Institute of Brooklyn, Department of Defense Research Agency, Institute of Radio Engineers.
- Apr. 15-22 - National Symposium on "United Space Station," Institute of the Aeronautical Sciences, Arlington Hotel, Los Angeles, Calif. Cosponsors: NAA, the Royal Corp.
- Apr. 21-Annual Eastern Regional Meeting, Institute of Navigation, New Yorker Hotel, New York City.
- Apr. 21-22-Space Week, 8th Annual Conference "Missions and Methods for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Commodore Hotel, New York.
- Apr. 27-28-National Meeting on Space Age "Missions, Concepts, Chapter of the American Society for Metals," Sheraton Glenview Hotel, Cincinnati, Ohio.
- Apr. 29-29-Inauguration of "United States Argentina Society," United Air Development Division, Wright Patterson AFB, Ohio.
- May 2-4-National Aeronautical Electronic Conference, Biltmore and Sheraton Hotel, Los Angeles, Calif. Sponsor: Institute of Radio Engineers.
- May 2-4-National Night Test Symposium, Institute of Systems of Aeronautics, San Diego, Calif.
- May 9-13-1967 Symposium of the Institute of Radio Engineers' Professional Group on Vacuum Technology and High Vacuum, Hotel del Coronado, San Diego.
- May 10-12-1967 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsor: Institute of Radio Engineers' Professional Group on Components.
- May 10-14-1967 Annual National Symposium, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.
- May 15-20-1967 Annual Congress, International Aeronautical Federation, Rand Institute of Technology, Stockholm, Sweden.



The New Ramo-Wooldridge Laboratories in Canoga Park

...an environment dedicated to technological research and development

The new Ramo-Wooldridge Laboratories in Canoga Park, California, will provide an excellent environment for scientists and engineers engaged in technological research and development. Because of the high degree of scientific and engineering effort involved in Ramo-Wooldridge programs, technically trained people are assigned a more dominant role in the management of the organization than is customary.

The newly-own landscaped site, with modern buildings grouped around a central mall, contributes to the

scientific environment necessary for the work. The new Laboratories will be the West Coast headquarters of Thompson Ramo Wooldridge Inc. as well as house the Ramo-Wooldridge division of TRW.

The Ramo-Wooldridge Laboratories are engaged in the broad fields of electronic systems technology, computers, and data processing. Outstanding opportunities exist for scientists and engineers.

For specific information on current openings write to Mr. D. J. Fyfe.



THE RAMO-WOOLDRIDGE LABORATORIES

3000 FULLERTON AVENUE, CANOGA PARK, CALIFORNIA

Electronic test and maintenance costs

REDUCED 90%

with the Tape-Programmed SUPERTESTER®



Dramatically reduced test costs, increased equipment reliability and quality, incipient failures located during routine measurements, decreased down time for vital equipment, production bottlenecks eliminated, no time wasted overhauling good units and needlessly replacing good components, exceedingly valuable in ground support—these are a few of the many reasons that CTI Supertesters are so widely used for all types of electronic and electrical testing from production to field maintenance. In making complete static and dynamic measurements on constituent circuits or in analyzing performance of entire systems, Supertesters have demonstrated time and again their advantages over other test methods.

Proven in over one year of use, the Model 180 Tape-Programmed Supertester is bringing a new meaning into electronic testing. With the accessory Tape Punch and Tape Duplicator, identical or revised copies of tapes can be made in seconds, an important feature where numerous design changes are of concern. Copies of tapes used by the original equipment manufacturer can be supplied for field use, always assuring that equipment is meeting the latest design specifications. In addition, lengthy test specifications are eliminated and the test instrument for a large variety of tests are kept to a minimum—on CTI Supertesters.

Write for complete specifications on the Model 180. A brief outline of your test requirements will enable us to advise you in more detail on the application of our testers to your needs. Related CTI products are the Model 165 Cable-Fluorescence Analyzer, Model 176 coil-programmed Component Tester, and Model 190 Supertester.

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DIVISION OF TETRONIX, INC.

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Product in Automatic Testing



The new Model 180 Tape-Programmed Supertester has the same outstanding features that have made CTI electronic test equipment the leader in the field—high accuracy, pin-for-pin budget measurements, wider range of tests and versatility operation, and complete on-site confidence in test results through fast-aid recovery and self-testing ability.

Engineers: Complete specifications are currently available at CTI.

Temperatures Made To Order... By General Motors!



EXCESS HEAT'S A STRANGER ON NEW BELL RANGER WITH RELIABLE HARRISON OIL COOLERS ON THE JOB!

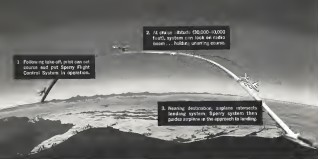
Whether it's a swift lift or a long haul... the new Bell Ranger comes through with dependable performance. And Harrison keeps engine oil temperatures steady for safe, sure flights. Wherever Bell helicopters go—over mountains, marsh, jungle or desert—you'll find Harrison oil coolers on the job, guarding vital temperatures. Harrison—with a half century of experience in the heat-transfer field—in your assurance of top-quality products that are researched, designed and tested for proven reliability. If you have a cooling problem, rely on Harrison for the answer.



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TEMPERATURES MADE TO ORDER
AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



LOCATED BETWEEN PILOTS: controls for Sperry flight control system. As well as automatic control of plane in all cases. Flight instruments integrated with sensitive pilot, give pilot continuous visual data of his control in flight.



UNITED AIR LINES DC-8 Jetliners in flight. System offers better flying, world's fastest and most efficient on the world's most direct routes. — the Douglas DC-8

Douglas DC-8 Jetliner Wins Acclaim

UNITED first of 16 airlines to fly new jets . . . called "major advance in air travel!"

THE STORY BEHIND THE STORY

The new Douglas DC-8 Jetliner—carrying 140 passengers in luxury and comfort at speeds up to 600 miles per hour—will be the first 5000 miles non-stop in new jet itself. But behind that news is the story of . . . another example of leaders in many phases of the aviation industry working together to make air travel more satisfying to the public, and more profitable to airline operators.

Sperry's contribution was development of the SP-30 Flight Control System—the first such system designed specifically for multi-jet commercial aviation. Engineered to provide precision guidance of the 150-ton DC-8 in the atmosphere, at speeds up to 10 miles a minute, the SP-30 enables pilots to fly with unprecedented ease and accuracy.

In developing the SP-30, Sperry drew on nearly 30 years of experience in automatic flight and instrumentation. Since Sperry built the first automatic pilot in 1912, thousands of aircraft, both military

and commercial, have depended upon Sperry for safe, comfortable and on-schedule flights.

For information, write Aeronautical Equipment Division, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, New York.

SPERRY



Helping to guarantee a vital "something" for a rainy day



The effectiveness of America's defense "umbrella"—today and tomorrow—depends on instant availability of superior electronic weapons.

For over seven years, the Hallicrafters company has been answering this urgent need with QRC—Quick Reaction Capability.

For your electronic requirements . . . from single circuit to complete systems . . . for application on land, sea, air or space . . . Hallicrafters QRC can provide you with this unique design and production service in electronics.

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MILITARY ELECTRONICS DIVISION CHICAGO 24, ILLINOIS

URGENT PROBLEMS RELIABLY SOLVED

engine power

BY CATERPILLAR

Sawyer AFB, Truax AFB CAT DIESEL ELECTRIC POWER assures adequate lighting in case of emergency

At K. E. Sawyer Air Force Base, Muskegon, Michigan, a Caterpillar D357 Electric Set supplies standby power for runway lighting. The set is equipped with automatic start-stop controls which enable it to pick up a full load in 4 to 5 seconds average.

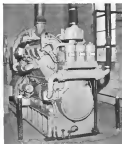
At Truax Air Force Base and Municipal Airport, Madison, Wisconsin, a Caterpillar D357 Series F Electric Set supplies emergency power for runway lighting and a CAN control tower. Landing beam lighting for controlled landings is also being installed on standby.

Caterpillar Electric Sets supply any quantity of dependable power from 30 to 375 KW. They are extremely efficient 4-cycle engines which operate on solo diesel fuels, ranging from JP-4 to No. 2 furnace oil. They start easily, pick up load quickly and can be operated and maintained by unskilled personnel. Parts and service are available throughout the free world.

Special high strength materials, strong reinforcing, simple compact design give Cat Electric Sets the stamina to operate for extended periods without stop. At Air Force Bases in the Atlantic, Cat Electric Sets have run over 20,000 hours without an overhaul, while supplying 60,000 kwh per month.

Here are just a few reasons why Caterpillar Electric Sets are in service at so many military and civilian airports. They include primary and standby power for testing, starting engines, alert hangars, radar systems, lighting, heating, heating and operating facilities.

Get the complete story on the advantages of Caterpillar Electric Sets. Write for our new booklet, "Guide Book on Emergency Power."



CATERPILLAR

Engine Division, Caterpillar Tractor Co., Peoria, IL, U.S.A.
Circle 1 on Reader Service Card



RTV (room temperature vulcanizing) silicone rubber being applied as sealant in Douglas DC-8 RTV runs without application of heat, won't crack (no shrinkage), forms no voids. It has excellent load strength, also resistance to high temperatures, moisture, weathering, ozone, air, road salts and solvents.

G-E RTV silicone rubber—a superior material for tooling, encapsulating and sealing



Protrusions (at angle from ones (right) cast in RTV mold. Every part cast in flexible RTV molds has a bright, glossy surface and responds extremely fine detail. No parting agent is required for even the most complex parts. High tensile and tear strength is retained even after prolonged heat aging.



Glass thermometer, substitutes of bellows gear case, vacuum in low cost, one piece RTV mold. Protrusions such as replacement parts had to be machined by hand. Now they can be quickly and accurately replaced by using the bellows part as a master.



Testing and encapsulating of electrical components, such as this vacuum transformer, are easy with RTV. It can be poured, injected, printed or applied by dipping. Encapsulate resistance from -60°F to +400°F. Excellent resistance to high alkali and acid and ozone. Comes in wide viscosity range.

For application data and samples of General Electric RTV silicone rubber, write to General Electric Company, Silicone Products Department, Box 203, Waterford, N. Y.

GENERAL ELECTRIC

Silicone Products Dept., Waterford, N. Y.

ESCAPE SLIDE / another product of Air Cruisers research



DEPENDABLE SURVIVAL EQUIPMENT

The Air Cruisers escape slide shown here enables passengers and crew to evacuate the aircraft in an emergency in a matter of seconds without injury. Simple to operate, it is standard equipment on most turbine-powered passenger aircraft.

Thoroughly tested by the military and commercial airlines, the inflatable escape slide is another major achievement in a field where Air Cruisers has been the leader for more than 30 years...dependable, lightweight survival equipment. The only manufacturer which con-

ducts continuous research in survival equipment, Air Cruisers is America's most experienced fabricator of inflatables from rubbersized nylon materials.

The Air Cruisers jet pump, which produces the rapid inflation vital to the fast, dependable operation of the escape slide, is another contribution toward better survival equipment. Today, more products, including life rafts, deceleration bags, etc., are inflated by Air Cruisers jet pumps than by any other kind.

Your inquiries are invited.



AIR CRUISERS DIVISION

ELIZABETH, NEW JERSEY

LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • GAS EXHAUSTOR BAGS • DECELERATION BAGS

BENDIX RDR-1D AIRBORNE WEATHER RADAR WINS IN SIDE-BY-SIDE COMPARISON!

Only Bendix has this proved performance superiority

	BENDIX RDR-1D SYSTEM	OTHER X-BAND MAKE
RACK SPACE REQUIRED	TWO 112 ATRs	TWO 314 ATRs (SHORT)
RANGE	60° TO 158 MILES	UP TO 50 MILES
STABILIZED ANTENNA	YES	NO
SCAN ANGLE	180°	120°
ANTENNA TILT	± 15°	± 10°
WEIGHT	50 LBS.	35 TO 50 LBS.
MAXIMUM NO. OF INDICATORS	TWO	ONE
AC POWER REQUIRED	100 VA	510 VA



Bendix RDR-1D System—TSC-1A3

New FAA regulations have put airborne weather radar in the forefront...and emphasized more than the importance of using the most efficient system. Extensive comparisons reveal that the Bendix RDR-1D System offers superior performance which means maximum flying safety for all types of aircraft.

The RDR-1D "sees" farther...up to 150 statute miles. Its stabilized antenna prevents loss of picture

while maneuvering...and the wider scan angle allows the pilot to see 50 per cent more target area.

Today over 1,500 Bendix Airborne Weather Radar Systems are now in daily service with airlines and business aircraft operators throughout the world.

For more details on the Bendix RDR-1D, the weather radar system with experience, write:

Bendix Radio Division
AIRCRAFT GROUP • ELIZABETH 4, NEW JERSEY



Bendix Radio and Service • Bendix International, 200 E. 42nd Street, New York 17, New York • Canada: Canadian Bendix of Canada, Ltd., P.O. Box 451, Ottawa 4, Ontario.

VICKERS ECM COOLING SYSTEM *plus*

3M's FC-75 dissipates 47 kw input in 74 lb package

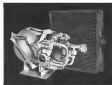
Vickers' 35 years of specializing in handling of fluids has been directed to "application-tailored" airborne cooling systems... reliable systems that are light weight and feature a broad range of flow and pressure characteristics.

This typical Vickers system circulates Minnesota Mining and Manufacturing Co.'s heat dissipating dielectric coolant, FC-75, through Sperry's advanced design electronic countermeasures systems.

Heart of the Vickers cooling system is a single-stage, centrifugal pump that generates relatively low pressure and moves fluids at high flow rates. Because it is inherently simple in design, the Vickers pump offers high reliability and simplified maintenance. Bearing design permits operation with fluids having low viscosity, as this instance FC-75, a fluorinated hydrocarbon.

Included in this package are safety interlocking devices for the protection of the pumping unit and ECM system. Maximum operating efficiency is assured even under unusually severe operating requirements. Such assurance comes from Vickers' proven skills developed by long experience in designing and building components and systems for handling all types of fluid.

Write for Bulletin A-8244 for more details.



PUMPING UNIT AND CORE. Large electronic cooling system developed by Vickers for Electronic Countermeasures defense systems uses all 3M's FC-75 dielectric coolant to dissipate heat from electronic countermeasures equipment. Unit's pump is equipped to be continuously run at 100 psi with fluid flow rates as high as 10 gpm, depending on size. Also —15° to +55°F. Operating with viscosity of 10 cP and dielectric breakdown over 1000 vdc while rated 30 lb, there's built-in part of the electronic cooling program controlled by Vickers to permit all the new design. It includes protection of both unit and core as well as electronic shock resistance and other physical tests.



AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

Division of
SPERRY RAND CORPORATION



THE RAW MATERIALS OF PROGRESS



HOW TO HOLD A JAM SESSION 8 MILES UP

Vickers active cooling system (inset) uses FC-75 as countermeasures system

The increasing sophistication of electronic countermeasures systems poses many problems. Among them—how to cool vital components at the environmental and operational extremes associated in static and dynamic combat.

For the Sperry countermeasures system, a new airborne active cooling system—capable of dissipating 47 KW in a 74-lb. package—was developed by Vickers using 3M Dielectric Coolant FC-75.

The great value of all fluids offered to electronics is high electric strength at STP. It is self-healing, and maintains electric strength after repeated high voltage arcing. It pours at —140°F

and boils at 312°F at one atmosphere... ideal for magnetic cooling.

Compatible with most materials, FC-75 is non-corrosive, non-flammable, non-toxic, non-explosive and odorless. It is thermally stable in excess of 500°F, and will not form sludges or gums under extremely rigorous conditions. These properties make it ideal as a coolant.

Investigate the remarkable properties of 3M coolants in terms of your own product design, manufacturing and performance problems. For free brochure, write to 3M Chemical Division, Dept. KAW-20 St. Paul 6, Minn.

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW



Military Space Bid

(Maj Gen G. J. Kilham, commander of the Air Force Missile Defence Division, simply stated what he viewed the strategic importance of space and noted that, in the interest of national security and military space progress he pushed through these developments under a top priority item. Because of the current debate over whether the military actually has a role in space and—if so—to what extent, AIRSPACE, which is appearing below as editorial content of Gen. Kilham's speech before a Los Angeles meeting of the Institute of Radio Engineers.)

We can no more ignore space from the security point of view than we can ignore the sun beamed on us in the atmosphere just above us.

We are not venturing into space simply because it is there, but because space is the new realm where strategic operations must well be conducted with great effect. It does not take a student of military history to recognize that the nation which has the courage and the foresight to tap the advantages of new theories of operation, and to forge ahead into these new frontiers, will inevitably become the leader. Until the Soviet nuclear breakthrough of 1949, the United States possessed a monopoly both on the nuclear weapon, and on the means to deliver it. That in effect, was absolute deterrence. From 1949 through the early fifties we no longer held a monopoly in the nuclear field, but we still retained the edge in aerospace. Now, however, we hold no monopoly—either in nuclear knowledge or in the means to deliver nuclear weapons.

As technology has progressed, time and distance have been compressed. The world, however, is not growing smaller. Rather, man is growing larger in his ability to command the forces of nature.

We are involved today in a conflict of ideologies with the Soviet Union. The so-called cold war is being waged along many fronts—political, social, economic, perhaps religious, educational, and technological. If the Soviet Union achieves a substantial edge in missile and space weapon systems, the blackboard capability associated with such a change of power could be used against the free world, perhaps as decisively as the weapons themselves. Conversely, the better equipped we are in modern hardware capabilities, the stronger will be our position at the diplomatic peace table.

Since it is imperative that we offset (Soviet) activities in such warfare and national advantage be safeguarded, we in the Air Force have taken concrete measures to develop space systems which will contribute substantially to our defense capabilities. Two specific programs are the satellite projects we call Midos and Seros.

Midos (Missile Defense Alarm System) is the Air Force answer to the requirement for early warning. It is the defender which will cut sharply into the Soviet advantage of surprise. An ICBM travels a quarter of the distance around the world in about 30 minutes. Because of its tremendous speed & altitude even the fastest intercept submarines given us by our present warning systems. At this time we have no active defense against it.

Simultaneous with our development of Midos, we are proceeding with the Seros program. Seros is the

Air Force answer for the global surveillance satellite system which will counteract the Soviet advantage of intelligence information. It is the man-powered military advantage of "high ground" viewed to the new altitude.

When a nation is confronted with the risk of war, it is important that those who must make decisions have the benefit of current and valid information about the other nations involved. If this information is not available, the possibility of mistakes and miscalculations is increased.

In proceeding concurrently with all aspects in the development of ballistic missiles, i.e., the construction of launch and the training of personnel while the weapon is still undergoing research and test we have demonstrated that calculated risk can pay big dividends in the forging of a major weapon system within a tightly-compressed time schedule. This same concept of constant review, and the priorities and funds that go with it, should now be applied to the expeditious development of our military space system.

We must meet the broad challenges of space. For through the intelligent exploration and exploitation of space, man can extend his horizon, contribute to his comfort and welfare, and augment his knowledge. He can do none of these things, however, and I emphasize that last, unless he commands the freedom and the means to exercise his full talents. In this critical age we must explore all promising ventures into space. It is vital that we equip ourselves with the knowledge that must be evolved from the unknown of space. Our two great objectives—to increase human knowledge and to defend human freedom—are important to each other in fact, but mutually preclusive. In the current phase, with warning and reaction times measured in seconds, effective communication will be a decisive element in future military operations.

While dependable, the delayed reaction communication system between a satellite and ground stations imposes some degree of delay in transmission. To overcome this the Advanced Research Projects Agency, of the DOD is investigating the unique characteristics of 34-hour orbital satellite systems. Three such satellites, each put into orbit 10-100 miles above the earth, would provide line-of-sight visibility to all points except those in the polar regions. Calculations show that a relatively low power radiated from the satellite to the ground station is sufficient for many purposes of bond width. Consequently, high capacity microelectronic communications will be possible.

We are well beyond the Buck Rogers era of science fiction. Space is with us—and we must get with it if we are to reap the advantages there for those who demand the forefront and have the daring to seek them. The stakes in this space race are astronomical, the rewards can be nothing beyond imagination. The penalty for tardiness, indecision, or complacency can be equally vast.



Johns-Manville Announces... MIN-KLAD INTERLOK

... a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Missile experience shows that in certain heat control situations no one material will perform as well as two (or more)—one insulated with protective high-temperature plastic.

Problem is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok.

A new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facings.

The result: one product that gives the missile designer every advantage of high-temperature plastic or metal foil—strength, toughness, rigidity! Eases maintenance! High heat capacity!

... gives the outstanding advantages of Min-K insulation—as insulating cover that has the lowest thermal conductivity available for service temperatures up to 3500°F. steady state, and higher for transients. Min-K's thermal conductivity is actually lower than the molecular conductivity of still air.

Wide range of facings
For the hot face, the missile designer can

specify Min-Klad Interlok in a wide variety of heat resistant and/or ablating materials—aramids-phenolics (ARAP-400), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal foils and panels. For some requirements, the cool face can be made of a different material—for example, one that offers characteristics required for bonding or fastening to other surfaces and parts.

Like all J-M Aviation Insulations, Min-Klad Interlok is factory fabricated to your specifications and external skin panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address: Johns-Manville, Box 14, New York 16, New York. In Canada, Fort Coburn, Ontario.

JOHNS-MANVILLE



All the above components combine to provide a custom-made structural unit for any missile application.



B.F. Goodrich producing high-energy solid propellants

This state-of-the-art is one of the 56 specialized facilities at the B.F. Goodrich solid propellant plant, Redlands, California. BFG-made propellants are currently being processed and loaded in solid fueled rocket motors of the LORX, RTV and ASP types.

B.F. Goodrich pioneered the development of the major polymeric binder-fuels now being used in our country's most advanced missiles. Liquid "C" synthetic rubber and polybutadiene BFG solid fuels are outstanding in their high energy performance, and have excellent stability, shelf life, physical properties at low and high temperatures, excellent burning characteristics and batch-to-batch uniformity.

B.F. Goodrich is qualified and equipped to handle complete rocket motor projects...from complete design through testing and shipment. BFG also produces rocket motor cases, case and nozzle liners and other parts in conjunction with complete propulsion systems. Test and production motors containing cast and core-bonded propellants grates in various sizes and weighing up to 1,000 pounds have been successfully manufactured and fired.

For complete information on how BFG solid propellant facilities can help you, write for a copy of the booklet "B.F. Goodrich Solid Propellants for the Space Age," B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Department AR-228, Akron, Ohio.



Loading a stack of small rocket motor case rings at the BFG Redlands plant after propellant has been poured into the cases. B.F. Goodrich has been engaged in composite solid propellant research since 1950—in motor production since 1955.

B.F. Goodrich

aviation products

WHO'S WHERE

In the Front Office

Chile Plans men serving vice president and general manager of Texas Aircraft Corp. Dallas, Tex. also served a director. Charles W. Gaudin, a vice president American Airlines, Inc.

Gen. O. F. Wyland (USAF, ret.) has been named a consultant to Aerojet-General Corp., Azusa, Calif., and a member of the corporate advisory board.

E. John Wolff, Jr., vice president and managing director of Aerojet-General Corp., Azusa, Calif., and a member of the corporate advisory board.

George A. Frank, president, International Electronics Co., Houston, Tex.

James H. G. Miller, executive vice president and manufacturing, Pacific Engineering Corp., El Segundo, Calif.

Henry C. Gull, vice president-engineering, National Vacuum Filter Co., Wilmington, Del.

Robert M. Thompson, vice president and general manager, Hamilton, Inc., Fort Worth, Texas, N. Y.

Kenneth A. Winter, vice president and treasurer, San Francisco, Calif., has become Chief.

Dr. Walter B. Case, vice president, United Control Corp., Seattle, Wash.

William D. Stone, vice president and general manager, Aero, Inc., El Monte, Calif.

Dr. Paul T. Smith, director of propulsion and flight research, Aerojet-General Corp., Azusa, Calif.

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INDUSTRY OBSERVER

► Air Force hopes to improve the quality of aerodynamic test data needed for the design of the Dyna Soar boost-glide vehicle through a series of logistic model flights using National Aeronautics and Space Administration's Chance Vought Scout rocket in a booster. Large-scale test flights are to include Mach numbers in the transonic range of the uncertainty now surrounding the Dyna Soar design, in the region of 0.8 to 1.0. Approval of the necessary financing and ability to obtain the needed Scout vehicles will be primary facts in determining whether the tests will be carried out.

► Project Tenset aerodynamic stability program is being attacked by Navy from 278 ft. to 50 ft. so that the relatively inexpensive Scout solid rocket can be used in a launch test instead of the originally-planned liquid-solid fueled Thor-Able vehicle.

► Advanced Research Projects Agency is expected to hold an open industry-wide competition for Project Squid, around anti-ICBM satellite program (AW Jan 4, p. 38).

► Federal Aviation Agency soon will call for industry bids for the development of a minimum-cost air traffic control computer for use by small aircraft. F.A.A. Bureau of Research and Development will hold a hearing session for potential bidders in Washington on May 11.

► An Air Force challenge program for an all-weather, long-range version of the North American Mustang II aircraft, mainly for the Boeing B-51, is substituting a Pratt & Whitney JT12 turbojet engine for the Pratt & Whitney JT2 engine used. Although the JT12 has only 1,500 lb. thrust compared with 7,500 lb. for the JT2, decreases in weight, frontal area and fuel consumption would provide additional speed and range.

► Monitoring procedures for the high altitude nuclear bursts conducted under Project Argus in 1958 included use of small satellites launched from Navy aircraft.

► Mobile atomic range system incorporating four KC-135 jet tankers in the carrier is being proposed by Boeing. Specifically modified with electronic tracking and data processing equipment, the results could be placed in a mobile atomic range system to monitor launches of U.S. space and military satellites. Antenna would be carried in a pod and located on top of the KC-135 fuselage. Boeing also points out that the aircraft could be strategically placed to monitor Soviet space and missile ranges.

► Stockholders in the Boeing KC-135 tanker program have received current production to seven or eight aircraft a month—approximately half that of a lower high production rate of 15 aircraft per month.

► Crewman for Strategic Air Command ballistic missile squadrons will be obtained previously through integration of the crewman's Boeing B-47 wings. Several B-47 wings will be deactivated, and the aircraft and crew members will be divided and assigned to two of the remaining B-47 operational wings. Ground personnel from the deactivated wings will be sent to ICBM squadrons and instantly assigned to operational missile squadrons.

► Soviet arms is believed to be installing defensive guided missile systems abroad in order to protect its surface forces.

► Target made for Army's Nike Zeus anti-missile missile in test firing in the Pacific will be the Army-Chrysler Jupiter target. The Lockheed Agma II target ship. The Agma ship, powered by a Bell Aircraft engine equipped with regenerative capabilities in present testing, will be fired on the very day after it has reached the highest point of its trajectory. Nike Zeus system depends on spotting the re-entering body at the high point of its trajectory in order to make its intercept. Jupiter Agma will be fired first from Johnston Island in the Pacific.



TRUE NORTH...anywhere-any time-any weather

A portable field instrument that finds true north into instantly is now available to America's new mobile Army. It is called ABLE and has been TYPE CLASSIFIED by the U.S. Army, TO & E No. 4000000 ABLE easily determines true north—day or night, in all weather, and anywhere in the world up to latitudes of 70 degrees.

The simplicity, speed, and precision of ABLE compared with surveying methods means a saving in time, man-

power, and equipment...and is in keeping with the goal of a Army's concept of battlefield mobility.

Heart of the 100-pound ultra-transportable system is a high precision gyro which senses true north. Its accuracy is equal to most colonial methods under tactical conditions. ABLE components have a mean time to failure in excess of 3000 hours. ABLE can also provide directional orientation for field operated mobile radar and missile launchers,

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Washington Roundup

Apparently increased concern in Republican Party circles over the defense issue convinced President Eisenhower he should take more positive action to rebuild Democratic attitude. First he went to Cape Canaveral, then he decided to discuss the issue on a national broadcast. And he decided to ignore the headlines as before leaving for South America indicating a concern over the recently increased policies of the state.

Eisenhower apparently intends to get his military reputation against all odds and depend on his prestige to carry him through the fight. He intends to stress his years of nation partnership and political astuteness. And he continues to stress his own military background and the objectives of his top military advisors.

A strong fight from Eisenhower could rally support to the administration position but probably not enough to offset Democratic control of the purse strings. If the Democrats cling to their determination to make defense an election issue they have more than enough power to vote extra money for conventional projects like the North American B78 Mach 3 bomber.

Mutual Security

Mutual security progress appears limited for the usual deep congressional cuts this year. Estimates of cuts run as high as \$4 billion from the \$4.175 billion budget the President signed on Congress last week. Progress includes about \$2 billion for military aid and this is included in the U. S. defense budget for the first time. Eisenhower saw \$2 billion as needed this year to still the depleted military aid program.

Military assistance element of the defense budget is ripe for cuts to make way for increased U. S. defense spending. Democrats are growing pressure for a bigger military effort and military aid is an easy place to cut to compensate for heavier domestic spending. This would keep the total budget from too great a jump and help the Democrats temper tax. Ford propounded: hold.

Presidential advisors seem to be edging away from the idea that the U. S. is not in a war with Russia. Senate subcommittee Group B Worldwide has spoken of the scientific and technological pact with the Soviet Union which includes our national prestige, and economic, perhaps, not (or second). Under the month Secretary of State Charles A. Bohlen revealed some international prestige to Soviet type outcomes. He admitted Soviet achievements have been more glamorous than U. S. efforts.

Hein would not work against allowing scientific advances to show the world to ground us through immobilization. He said a close state military government to control the design of a continuing arms race and opening competition in strategic defense activities.

Electronics Boomerang?

Some electronics firms are about the Electronics Industries Assn. fight against Japanese imports (see p. 18) are loosening. Seeking to not set targets of Japan to use electronics. EIA has sponsored government supported research and some profits from commercial sales and future research in military products. Some EIA members are afraid the Defense Department might ask industry to apply this philosophy to development of defense electronics equipment.

There is little prospect for action this year on proposals for a single center agency. Sen. Stuart Symington (D-Mo.) joined the ranks of single agency agencies but a risk taking for an integral military civilian center under one top level official. President Eisenhower is strongly opposed to such a move, and so is congressional support for it has developed.

State Department is expected to hold firm against leaving Dutch program for its entire route to Los Angeles. Netherlands has sold Services of State Dept. of its disappointed and the Dutch government has joined a resolution along the U. S. to increase its defense and peace KLM Air Dutch Airlines to fly to Los Angeles. State is expected to stand by its refusal.

Wrapup

House Judiciary Subcommittee launched hearings last week on proposed bills to strengthen the federal control of interest rates. Commerce Department has completed its study of national transportation policy, and it is ready to go to the White House for approval. Congress, who is asking for a permanent staff to conduct a continuing survey of airport pilots. Senate Commerce Committee will hold hearings this week on the nomination of New York in the Civil Aeronautics Board.

—Washington Staff

U.S., Soviets Race to Develop Air-Launched

Bearing B-52H will carry GAM-87A Sky Bolt; Soviet plans to use Bear turboprop, Bomber platforms.

Washington—United States and the Soviet Union are in a new technical support race to produce an operational air-launched ballistic missile. The U.S. program is based on the GAM-87A Sky Bolt ALBM which is projected to boost the strategic strength of missile bombers by adding a new generation to ground offensive punch.

The U.S. has decided to produce the Sky Bolt for use on the Boeing B-52G and B-52H jet bombers which are now carrying Hound Dog missiles (AW Feb 8, p. 35).

The Soviet development program is already under way. Plans probably are to use the ALBMs on the Bear turboprop (several hundred are now in service), on the Bomber supersonic delta now in flight test stages, and, in particular, on its on-ice/ground versions.

Because to put the WS-155A program (space program for the Sky Bolt) into its development phase is based on design-objective comparison in near future stage, however, and (possibly) Department of Defense decision, weighed by Director of Defense Research and Engineering Robert Taylor, among two critical capabilities are:

- **Control the GAM-87A**—It is developed to operational status within a reasonable period before the time when coming missile bombers can be considered to become obsolete? This broad requirement may have been tied into a tentative projection for initiating phase-out of the North American GAM-77 Hound Dog air-launched air-to-air missile in 1967 and phasing in the GAM-87A at that time, with complete transition to the latter by 1968. This possible timetable for GAM-87A use, has been discussed in the probability of extending in years of performance versus of Hound Dog, which is being produced by North American.
- **Control accuracy and reliability** be developed, within the tractable limit, to give an "almost on target" but capability required for a strategic weapon of this type? By the time GAM-87A would become operational, weapon analysts feel that its circular error probability (CEP) may be dominated in hundreds of feet.

Nuclear Warhead

The two stage solid-propellant GAM-87A missile to be developed by Douglas Aircraft Co. is the largest yet planned for air launch with a nuclear warhead. It is seen by industry weapon-analysts as following the general pattern:

- **Launch into a 200- to 300-mph high out-of-atmosphere**—ballistic—rebooster (500 mph) speed from a launch altitude between 35,000 and 45,000 ft.
- **Attain a speed of about 3,000 mph** after launch, probably air-launching at a substantially higher speed, for rebooster reentry to near missile velocity in a follow-on trajectory for target impact.
- **Span a range of 1,000 to 3,500 mi.**, depending in high degree of accuracy for the launching bomber by allowing it to release its weapons far less the target.

Utilization of the GAM-87A is seen by industry analysts as working out this way:

- **Boeing B-52 Model G** (the development and operational model) and B-52H (the operational model) will be the only USAF bombers tagged to mount the GAM-87A, according to present projections based on the anticipated status of Strategic Air Command bomber inventory. The B-52 would carry one missile under each wing.
- **Launch of a single missile** now introduces a new problem of asymmetrical loading, since the missile can weigh as much as 50,000 lb. This may require launch of both missiles simultaneously.
- **British V Bombers**—"Blindies" (see Vickers and Avon Vickers ML-2) probably will be modified to carry the GAM-87A—perhaps in a left position because of weight considerations. This application may use a scaled-down version of the missile.
- **British Air Vickers and Royal Aircraft Establishment** representatives were in this country last September discussing details of possible deployment of GAM-87A on the "Blindies".

If a reboostered bomber is developed to operational status, it also would be armed with the GAM-87A. Availability of the missile, at very least three to five years before a U.S. nuclear-powered plane might become operational, brings into sharp focus the earlier availability of that type of missile and plans coordination in Britain.

GAM-87A is not planned for use on USAF's Convair B-58. Fitting it to this bomber would have introduced difficult engineering and safety issues of close space between follow-on missile and wing root.

North American B-70 Mach 3 ultra-sonic bomber also will not be programmed for arming with the missile. Under the original timetable for the B-70, first probable delivery of an operational plane would not be before late in 1964, with first wing deliveries not before late 1965. Strategic Air Command has been anxious to overhaul the GAM-87A for the B-70, probably an interrupting at least a five-year utilization on the plane, followed, perhaps, by transition to nuclear-powered bomber.

Initial Study
While waiting for the Defense Department signal to begin the development phase of WS-155A, which may involve funding of approximately \$125 million, weapons industry prime contractor Douglas Aircraft Co. had completed its initial study effort. This basic study had been funded with an additional \$5 million to carry it to the middle of February. Early in the study, Aeronautics General

Ballistic Missile

was awarded the subcontract for the solid-propellant rocket motor. General Electric was given the job to develop the safety valve.

Last fall, Northrop Corp.'s Electronics Division was awarded the usual guidance instrumentation. Competition for an universal test air-ground checkout equipment for the missile was also scheduled. This was assumed to take months, then months held in abeyance, with indications that Air Force staff would review this equipment instead of developing development and procurement to a contractor.

Transition Period

During the transition period which usually follows the end of a feasibility study and leads into the research and development phase, Douglas gave a detailed presentation of status and progress to a full government and industry committee composed with the weapons arms—including Department of Defense, Air Research and Development Command, USAF Headquarters, Strategic Air Command, Wright Air Development Division project personnel, and industry members including Northrop Division, Aeronautics General, and Boeing Aerospace Co., and others. Apparently, this was Douglas' final report before the Department of Defense decision to support the follow-on development phase.

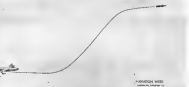
A broad band of weapons system analysts representing seven industry companies have studied the general parameters of air-launched ballistic missiles. These studies grew out of the intense industry competition before Douglas was awarded the WS-155A contract.

Indications are that general characteristics and mission requirements for this weapon system would have to fill into their broad bands:

- **Solid propellant rocket motor** to give adequate performance for a weapon of this type would be about 25 ft long overall and about 1 ft in diameter.
- **Allocating this to two stages** probably would give a booster stage of about 15 ft long, plus a second stage about 7 ft long behind the nose section. A single stage missile also would be applicable, but would introduce considerable size in target.
- **Booster stage** would have long and low fuel fins to coincide with long booster configuration. Second stage probably would use ground surface. One scheme might have carried no fuel at all in atmosphere contact with jets in the nose fed by a solid-propellant gas generator for out-of-atmosphere contact. Reverse thrust on fins in the leading edges of the casing



ARTIST'S conception of an air-launched ballistic missile shows flight pattern in the weapon is fired from a B-70 at 35,000 ft altitude. Then starts climbing steeply into a ballistic trajectory. After booster stage burned and separation, the second stage would push the warhead to peak altitude before the weapon begins reentry. As first stage is jettisoned.



PROFILE curve shows what's meant of an ALBM heading for out-of-atmosphere trajectory shortly after launch from B-52.

Contractors to Share Development Costs

By Philip J. Kiss

Washington — Defense contractors beginning July 1 will have to dig into profits to underwrite part of the cost of company-initiated development programs which formerly were treated as fully allowable items of expense for cost and incentive type contracts, according to new principles enacted in a recent revision to Armed Services Procurement Regulations.

An AFCEC already has called in more than a dozen major contractors to tell them that they must now share the cost of company-initiated development. As AFCEC reportedly is asking companies to share about 50% of the cost of development but is suggesting each agreement on an individual basis.

USAF has concentrated considerable objection from industry to the new policy because contractors feel it is another blow to their margins which were being already squeezed low (AW Feb. 15, p. 10).

The new AFCEC policy, and the contract action which goes into effect July 1, do not apply to development programs specifically authorized for by the services. However, this might be the next step.

Company-initiated research—which the revised ASPR defines as the search for new knowledge or better understanding as differentiated from development work which normally results in hardware—will receive more liberal treatment than in the past, however.

Previously, company-initiated research was not an allowable area of indirect cost unless government for it had been made in the company's defense contracts. After July 1, such areas will be allowable, pending the company's proposal as to research costs to all company projects, including commercial and industrial as well as defense.

Reasonable Research

Company-initiated research (and development) must both pass the test of "reasonableness" before they can be considered as allowable cost items under the new ASPR revisions. In evaluating whether such programs merit this status, government negotiators will consider size, cost and scope of previous company research and/or development.

Another, and more controversial, criteria for allowability, that will be applied solely to company-initiated development programs is that they must be "related to the product lines for which the government has contracts (with the company)."

The revised ASPR also rules out the establishment of "segregated" develop-

ment cost for and subsequent charge-off against future government production that might result.

The purpose of this provision is to prevent the use of taxpayer money to put a company into new types of business, but in the long-range defense business, this provision probably will create a number of thorny problems of interpretation.

For example, if a company is currently producing an airplane under government contract but decides to establish a company program to develop a new or improved engine, is this effort "related to the product lines for which the government has contracts?" Because the development effort is in the propulsion field, and for application to aircraft vehicles, the committee can be expected to agree that it is related. But only if the subcontractors of the engine and ASPR, such development should be divided into a new SGM of materials and one that the company should finance out of profits.

Reviewing Committee

To resolve questions of the cost, and to review proposed company-initiated research and development programs of major defense contractors, a Tri-Departmental Committee for Administration of Research and Development is being established in the Defense Department. It will include both contracting agencies and government scientists. The latter will advise company programs and recommend whether they should be included in research or development and related to production for ASPR purposes.

If a legitimate approach is used to increase the related research production ASPR, and the new ASPR revisions might lead to "hoarding" development, which contractors would develop work as diagnosed to appear to be related to current government production when, in fact, it is used at a low rate of cost.

Even if company-initiated research and/or development programs get over the hurdle of reasonableness and relate to existing production, contractors can expect to be asked to share the costs of such effort. This new ASPR Section 15 suggests that "cost sharing (between government and contractor) . . . may include contribution for some efficient development programs."

The section also says "it is desirable . . . to see that the government has less than an allowable share of the total cost of such programs." This can be done in several ways.

• Government accepts full costs of certain specific projects as allowable items

of expense but completely disallows costs on certain other projects.

• Government accepts a percentage of contractor's planned research and development programs as allowable, with the company bearing the balance.

• Government and contractor agree on a maximum dollar value that will be treated as allowable items of expense.

Air Force Views

Explaining the revision behind USAF's recent action, which interpreted the new ASPR revision, an Air National Command spokesman told Aviation Week that the request of companies initiated research and development which contractors seek to write off against production contracts has grown by leaps and bounds in the last several years. This, coupled with demands for increased production, has caused increased requests for cost sharing.

As a result, AFMC feels that a suitable portion of its funds intended for production of hardware is going to be diverted to company-initiated research and development, which is not the function of the command.

Company-initiated development has long been a source of friction between some of the services and some contractors. Over the several years of view, these development programs, so often as financial attacks with defense funds, yet the service has had to control over the direction of the company effort. Furthermore, the government normally is not allowed to share in the cost of such work unless government-sponsored programs.

Industry's position and particularly among companies which have industrial and commercial businesses, is that a standard practice to conduct company-sponsored development and allocate the cost of such effort to current production is an indirect charge.

Some industry representatives feel the new policy is part of a continuing effort to drive down profit margins on defense business. Industries are that some of the services plan to grant higher profit margins on defense business, to share increased contractor expense from the development sharing jobs. As the Defense Department official explained it is Aviation Week, "Industry will have to finance their efforts out of cost. It will be the price for driving down to defense technology to assist future business, or the cost of development programs."

Defense Department is now trying to end the "cost sharing" for a long time the new ASPR principles to share information interpretation for the direct

USAF would have high demand side, probably would want shifter for an engine, ability for an engine stage.

relatively could operate to meet operation of second stage from peak.

• An alternate plan, instead of using gas for out-of-atmosphere control, might involve thrust recovery through use of jet in the exhaust stream, or through use of rocketed nozzle, since each stage likely will use smaller multiple nozzle instead of a single large nozzle. Thrust recovery, producing is unlikely due to complexity involved.

• Operational technique likely will be for the missile to be cut loose from the launch airplane at about 40,000 ft altitude, a relatively high altitude to provide a safe margin of drop but only a short time fall would be prolonged before the first stage would ignite at a safe distance below the aircraft. A guidance signal from the launching aircraft would direct the missile from its present fixed forward attitude into a ballistic trajectory. During time would be relatively short—probably less than a minute—the first acceleration to peak altitude, perhaps 200 to 300 mi higher than the launch point.

• Present guidance computer logic probably would "anticipate" trajectory and target achievement. It is reasonable to assume that the missile will be fired with a ballistic trajectory of achieving a substantial number of alternate targets, according to a complex system of programming. Missile analysts feel that as many as 24 alternate chances would be available for a missile of this type of long effective trajectory capability to be achieved.

• Targeting capability will take on prime emphasis, might be aimed at achieving accuracy as the sides of heads-on, first, intercepting enemy capabilities at the first time the G-47A would become operational. Closely tied to such capability will be the ability to predict rocket motor thrust levels within a relatively low percentage of tolerance, both on the booster and on the second stage.

• Future operational refinement, not likely to be projected for first generation

operational missile, might be the inclusion of a television capability in the nose, which could transmit a picture back to the launching aircraft for in the next, to identify the target on which the warhead would impact.

• Various components undoubtedly will be needed. One of these areas would be redesigning of warhead systems, which change of design. Estimates are for a vehicle of this type, using auto-connection procedure, require capsules likely to be available when the missile is approaching operational status, that each stage would of course weight will likely nearly one mile from range capability.

• All-weather lightweight nose cone probably will be favored—greater detail in overall shape. High temperature plastic materials for the type of current use have increased capability to survive.

• Relatively shallow entry angle—perhaps not exceeding 40 deg—likely would result from a trajectory program which would be calculated to ensure a reasonable out-of-atmosphere altitude with adequate horizontal "reach." This shallow entry would cut down the heat from friction of a plastic nose cone material were used.

Soviet Pacific Tests for ICBMs?

Washington—Soviet Premier Nikita Khrushchev related in the weekly news item by Moscow in the Pacific Ocean is "several unexplained ballistic missiles," in a speech before the Indian Parliament. For the first several weeks after Moscow announced that the first missile would be made, all Soviet "missiles" of "medium" or "small" size, and the words "intercontinental" and "medium" was not used. Recently, however, both words have been used by Communist commentators (AW Feb. 15, p. 31).

Initial study effort at Douglas has not been limited to theoretical analysis. Initial procedure is to investigate some of the more difficult design factors in a few versions of the missile as tested with speed ranges exceeding the speed predicted for the operational missile. Fits for out-of-atmosphere control is one item which might be evaluated in feasibility studies.

Tripartite development will have to be reasonably free of all components of the weapon system—missile, aircraft and missile computer, standard component—so to be brought along concurrently to meet initial operational capability, which was told three years.

Considering the number of operational aircraft on which the weapon would be deployed, along with space requirements for launching and dispersal, global locations, quantities for testing during the development phase, and on time or crew training exercises to maintain operational efficiency, a total aircraft between 1,500 and 2,000 of the missile probably would be required. This would require a global buildup to a fairly high production rate—consequently in view of that shared with any surface-to-surface ballistic missile systems.

Automatic test equipment to service the missile's complex circuitry and sequencing may be one of the factors contributing to the original development timetable delay because decisions have not been reached for test set procurement. Estimates are that at least 15 of the test sets would be required to meet the demands of the development, production, and operational phases for the missile. Programming equipment probably would have to be transportable by air for availability at any launch base.

Test set would require heavily the reliability of components and it is likely that systems test set would be held to a minimum. Capability to keep abreast of missile refinements also would have to be built into the test.

yes. Within the next four to six weeks, the Defense Department hopes to issue final instructions and have the T-Deputations Committee established.

Approximately 55 defense contractors known to have extensive computer-aided research and development programs already have been invited to submit reports which describe their specific programs for evaluation by a group of non-securement scientists which will serve on the T-Deputations Committee.

Union Opposes Industry Position On Japanese Electronics Imports

Washington—Electronic Industries Assn has warned that the government must either restrict the export of Japanese semiconductor or else "walk into a full-scale program of direct government assistance." In the U.S. semiconductor industry it is believed the risk of a second electronics industry.

EIA's warning is contained in its report to the recent Japanese reply to the president's "open markets" policy. The Office of Civil and Defense Mobilization (OCDDM) is taking action to restrict semiconductor imports from Japan (AVF Dec 28, p. 24).

Opposition to EIA's stand and support for the Japanese position comes from as unexpected source—the International Union of Electronic Radio and Machine Workers (IUR), which recently filed a statement of union views with OCDDM.

The IUR says that, as a representative of employers in the electronics industry, it is as eager as others to see that American industry and American workers are not being eroded by competition from abroad. "But it urges the OCDDM to value its economic study to determine whether the higher prices of U.S. semiconductor result from higher unit labor costs or from currency problems."

Citing EIA's own figures that U.S. industry's transistor sales for the first 11 months of 1976 were up 67% over the previous year, after a similar gain up by 49%, the IUR said "it is very difficult to see that an industry which is growing as fast as an industry being eroded by Japanese imports."

Figures released last week by EIA showed that during the 12 months of 1976, U.S. producers turned out 75% more transistors than in 1975, with dollar sales almost double those of 1975. Electronic Industries Assn figures in its government report show that 1974 approximately 290 million transistors will be required for defense needs. This, EIA points out, is two and one-half times the country's 1976 pro-

duction and almost one and one-half times its estimated output for 1980. (American Wire analysis of figures on local output by EIA shows that U.S. transistor production has increased one and one-half times in the last three years and has gone up by a factor of about 3.1 in the past five years.)

The association says that, "unless the government enforces some control over Japanese imports of semiconductor products, the domestic industry cannot be expected to sustain continued capital investments to plant and facilities to meet national defense needs nor should it be expected to finance research programs that are vital to the growth of the industry and which contribute greatly to national technology and its advancement."

The same week in which EIA filed its answer to the Japanese, Public announced it was raising prices of silicon and germanium transistors up to 12%.

The company also said it is constructing a new \$115 million manufacturing facility for production of silicon transistors.

EIA draws the Japanese position that semiconductor trade protection, which Japanese export, as a separate matter from the higher quality transistors used for military applications. The reasons are both military and non-military industries involve similar manufacturing processes and "generally most of the same production line."

Generalized controls used to control goods markets and for outside defense. "An open market for the same government hardware and defense used in commercial equipment," EIA claims.

In answer to the Japanese statement that its semiconductor export represents 1.5% of the U.S. semiconductor industry's output in dollar value, EIA says that U.S. manufacturers "can hardly cost solely on the military market. Unless they can finance profitable commercial markets, they would have little, if any, production for continuing in business. The general growth of the (U.S.) semiconductor industry is di-

rectly attributable to the evolution of new products and the possibility of large markets and not because of possible speculative military needs," EIA says.

(During the same week EIA submitted its reply to OCDDM, Transistor Electronics Corp., producers of diodes and transistor products for military and industrial use, reported that its quarter sales were up about 16% from the previous quarter, with earnings up 12%. On December quarter sales of \$11.8 million, the company showed a net profit after taxes of \$1 million.)

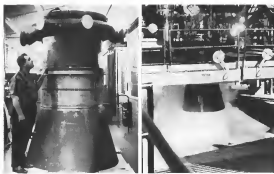
The Japanese had cited several major U.S. semiconductor manufacturers who voluntarily chose not to make transistors for the nonmilitary market. The Japanese also cited a document by Ruckelshaus made prior to the month of Japanese imports to abandon the consumer market and concentrate on military/industrial type semiconductor devices.

EIA counters that government semiconductor procurement programs contribute to technological improvements in military electronics, including non-semiconductors. However, EIA says that, if OCDDM trade shows a "dependency of the industry upon government-subsidized research, a serious question will be presented as to whether it is appropriate to use such means preferential to maintain life and vitality of the entire industry."

The IUR, in its statement filed with OCDDM, says it believes "maintenance of reasonable opportunity for Japan to export to us is necessary to keep in mind the economic action against Japan would be continued by other nations in the beginning of similar actions against them, since there is no reason why a similar policy would not be applied to almost any exports in which a national security consideration can be developed."

"There is no doubt," IUR says, "but that the security of our country would be endangered were we to lose our transistors and other semiconductor products in the trade field."

The union cites a number of U.S. electronics firms, some of them domestic semiconductor producers, who have bought into Japanese firms and/or are negotiating technical cooperation or co-product arrangements with them. IUR says that "if, as the (EIA) pretends, Japanese exports are being bought by the national security of the U.S. and, if American companies are asking these Japanese imports, can it be therefore deduced that by their activities (these) American companies are helping to undermine the national security? We say no—selling to make some a change, but does it not actually flow from the nature of the very persons that last been filed?"



UNCOOLED test device (left) has Rocketdyne F1 thrust engine has been run at over 1 million lb thrust. Test chamber was producing that power (right) when photograph was made. F1 is being developed for National Aeronautics and Space Administration.

Space Technology

NASA Studies Lunar Landing Projects

By Fred Fontana

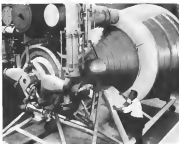
Washington—Soft lunar-landing systems for the Apollo-Centaur and Saturn boosters and gas cushion techniques to absorb the impact of uncontrolled hard landings are under study by National Aeronautics and Space Administration.

Richard V. Rhoads, NASA's assistant director of research for structures, materials and aircraft operating problems, told the House Committee on Science and Astronautics last week that the gas-cushion because of its "attractive simplicity," is undergoing extensive theoretical and experimental investigations in its research centers.

Three Methods

Three methods for safe landing on the moon surface were described by Rhoads—leaves, structures, pressurized spheres and gas cushions.

Under the latter and most attractive concept, the environment package is suspended from the cushion by a number of radial cables. Upon impact the cushion compresses and the entire environment comes to rest on the lunar surface, absorbing the energy by own means of flat gas shock waves gener-



FAIRLY FULL-SCALE testing of the Rocketdyne F1 Rocket engine (AVF Dec 8, p. 24) shows ground development. When checked, the engine could produce up to 5 million lb thrust, sufficient to place about 136,000 lb of payload in a space orbit.

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which blanket most major cities in the West. Dinkelacker said, "Hawaii's heavy traffic could be used to San Francisco and Los Angeles on Western jet flights from such distant points as Mexico, Alaska, St. Paul and such heavy ports from centers as Denver and Salt Lake City." Western also has an interest in the extension of San Diego on the Hawaii coasting route it is now the only major Pacific Coast city lacking this service.

Initial service from San Diego would be on a daily basis to Hawaii during the peak summer tourist season, and twice weekly for the balance of the year, Dinkelacker said.

The airline president told the Board that tourist volume in Hawaii would be improved further by Western's plans to establish joint first-class fares with

Hawaii and Aloha airlines to permit passengers traveling from the mainland to make a stopover in Hilo as en route change. Dinkelacker added that because of CAB's investigation into fares charged to the main islands and a personal belief that they might later become competitive with other airlines, Western could be in a position to provide such two-flight service to the "big island" pending a traffic building.

Dinkelacker also expressed concern over a daily service to Hawaii during a Hawaii-Los Angeles-Mexico City route, which would severely handicap Western's operations into Mexico City if the airline's trans-Pacific application is denied.

Taking the prospect of foreign airlines in Hawaii into account, Dinkelacker said, Real American, the Hawaiian carrier, has

presented plans to inaugurate service from Honolulu to Mexico City and then Los Angeles to Honolulu and beyond. Since Hawaii competes over a Hawaii-California-Mexico City route, it also could result if Philippine Airlines resumes service, indicated again by the airline's president, Dinkelacker said. He said that Japan Air Lines might seek to add Mexico City to its present Tokyo-Honolulu-Los Angeles route.

Dinkelacker told the Board that the requested Hawaiian route pattern, ranging from 2,800 to 2,680 mi. from the three West Coast cities would be "ideal" since it would increase the airline's average flight stage length by about the 5,000 mi. range considered necessary for economical jet operations.

FAA Says Decca Fails Helicopter Trials

Washington—Decca Mark 3 navigational aid system is the present design fails to meet the Federal Aviation Agency's standards for a primary IFR system for helicopter use, the agency concluded following a year of flight evaluation in the New York area with its own and New York Airways helicopters.

FAA says the Decca Mark 3 lacks the operational reliability and accuracy required and that its demonstrated accuracy "was well below the high requirements stated in published descriptions of the system and delineated in theoretical accuracy studies."

The report, prepared by FAA's New York Aviation Facilities Experimental Center, states that "within the accuracy and other operational and technical limitations described . . . Mark 3 can be useful as an en route aid for low flying IFR helicopters in certain areas, provided that:

- Operations are restricted to fixed enroute type routes between preselected terminals so that the preselected pilot or chart would contain the pattern—containing per during the entire flight.
- Operations are within a 10-mile radius of the airport's helicopter air strip.
- Plotter charts are constructed correctly from a very large number of actual receiver readings made on the area to be flown.
- Two pilots are in the cockpit so that the required close attention can be devoted to the nonflight component.
- Dual Decca equipment is carried in portable containers, needed for a primary IFR aid.
- Other navigation aids and strict rules are available for supplemental use.
- Plotter trainers are added to alert pilots to constant carrier or plotter in operation.

The FAA then intended to evaluate

the usefulness of a low frequency, hyperbolic navigation system for helicopters, scheduled 1968 for operational use of Decca by New York Airways helicopter and about 750 lb. of special test testing in an FAA helicopter.

Fixed-Wing Decca Tests

The FAA also ordered the fall report on its evaluation of the Decca Mark 30 system as a fixed-wing aircraft navigation aid. Test results were first reported by Aviation Week (June 18, p. 27, Jan. 11, p. 30). The Mark 18 is a more basic, automatic version but

flight tests separate from the Mark 3. In its conclusions, the FAA report said that when the Decca Mark 18 is working properly, it provides easy to use ground observation and track but not data. However, it failed to meet FAA's criteria for a primary IFR navigation aid for the following reasons:

- Does not provide continuous information, forcing pilots to select to other navigation aids.
- Two pilots are needed to operate the Decca equipment and operate the air traffic in some air traffic control situations.
- Charting problems limit the system to air traffic type operations on fixed routes. If substantial deviations from these routes are required, separate charts are needed.
- Operational reliability was below acceptable standards for a primary IFR aid.
- The FAA report also said that the Mark 18 is somewhat better than a navigational aid than other systems, but is still inadequate to operate in comparison with today's standard IFR primary aids.

Pilots Seek Duty Cut

For American pilots have advised their companies that as of May 16 next, will not accept flights involving more than eight hours of flight deck time. Companies, has requested that pilots who refuse such flights will be "subjected to appropriate disciplinary action. Only pilots equipped at all times for eight hour flight deck duty limitations covering pilots on job was written into the Feb. 4, 1959, agreement between Pan American and the Air Line Pilots Assn. Pilot contracts that ending flights of more than eight hours flight deck time would be in extreme fatigue and to endanger the lives of crew and passengers.

Two more the company of more than eight hours that call for flights of up to 11, 99 min in duration. Companies agree that the flight deck duty limitations are needed at the beginning, middle and then dropped by the pilots in exchange for other company measures. While some "union leaders" have been anxious to staff the crew to require less overtime work on the company. For American want the flight pilot union to accept the flight pilot union's Executive Council.

FAA's fixed-wing Decca tests were more limited than in helicopter evaluation, with a total of about 150 flight hours accumulated by seven "highly qualified pilots." Prior to flight evaluation, each pilot received a minimum of 12 hr of flight demonstration and 6 hr of ground instruction, according to FAA.

In the fixed-wing evaluation, 13 to 17 second, low altitude, one-way runs of four selected routes—JFK-LAX, New York-Washington and Atlantic City-Midwest to Philadelphia, N. J., back to Midwest on a direct route, Midwest to Montreal to Atlanta and back to Midwest, and Midwest to Boston and back.

After each flight the pilot was asked

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- to fill out a questionnaire, and the Decca flight log chart was removed for analysis. Following is a summary of pilot comments: (Where figures do not total 100%, the balance represents lack of pilot comment).
- Were there discrepancies between Decca charts and flight log after refueling? 24% yes, 64% no.
- Did any discrepancies occur between Decca charts and flight log during flight? 46% yes, 47% no.
- Were there any uncomfortable occurrences of the flight log during flight? 52% yes, 55% no. On the ground? 59% yes, 47% no.
- Did the new identification work properly? 48% yes, 37% no.
- Did the flight log require marking or present difficulties, when entering a Decca area? 29% yes, 21% no. In foreign areas? 88% yes, 11% no. In domestic charts? 47% yes, 29% no. In changing Decca charts? 58% yes, 31% no.
- Were you able to comply with ATC clearances while using Decca? 54% yes, 36% no.
- Were you able to stay within company structure area limits? 21% yes;

- 42% no.
- At any time were you unable to hold action prescribed holding pattern? 18% yes, 42% no.
- Were you able to navigate by use of Decca charts only? 29% yes, 59% no.
- Were you able to use Decca without assistance to another airport? 26% yes, 49% no.
- Did the flight log geographical presentation cause difficulties at any time? 21% yes, 57% no.
- Did route deviations cause a correction to the use of flight log at any time? 12% yes, 52% no.
- Did you find initial setting up of equipment to be difficult? 56% yes, 31% no.
- Did you believe equipment to be operating properly at any time? 49% yes, 34% no.
- Did you find it possible to locate an operating point off the printed routes? 48% yes, 35% no.
- Did operation of Decca equipment make it difficult to carry out other enroute procedures coordinated with your flight from two-pilot IFR operation? 48% yes, 11% no. From single-pilot operation? 56% yes, 22% no.

Vertol Studies Third-Turbine 107

New York—New York Airways has selected its new vertical Vertol 107 twin-turbine helicopter (AVJ Jua 15 p. 41) with a third engine if needed for all-weather operation.

Robert L. Cummings, president of the helicopter airline, and the additional personnel might be needed for all-weather operations, although he hopes it won't. The 25-passenger aircraft will be equipped with General Electric GT58-100 turbo-shaft engines. New York Airways expects to receive five 107s for service by spring 1961 and a final five by the end of 1962.

Price of the 107s, Cummings said, totals about \$9 million for the fleet of 10, at about \$4 million per airplane and \$20,000 for each engine plus spares.

The order involves a trade-in arrangement with Vertol covering the airline's present fleet of five Vertol 440 15-passenger helicopters. Vertol expects to sell the used 440s without difficulty, according to President Don R. Bollen, who said there is an "adequate market for them in other countries. Cummings and New York Airways itself had had some success in making possible purchase of the 440s "that look pretty good."

With the first five Vertol 107s in operation, New York Airways may increase its aircraft requirements to a quarter of what this, are now, Cummings said—assuming the airline agrees the more aircraft it needs. When all

10 Vertol 107s are flying, the airline should be able to operate 54 routes out of a new and to go off island, Cummings said.

With the new aircraft, New York Airways should be able to reach an operating performance factor of 85-90% at a "reasonable" cost, Cummings said. Performance factor now averages about 70% annually, with a low of 61% during some months.

Incidents and interruptions, rather than velocity, are the chief weather factors which hinder performance, Cummings said.

Next round of equipment planned for New York Airways is the 60-passenger Learjet 3600 VFL, which Cummings said would be available in late 1960 and for which the airline has signed a letter of intent to buy. Cummings said the Learjet has a more problem, which he is convinced is of a technological nature and which he is sure Panair will solve. "But this I have to solve it before we'll touch it," he added, and said the manufacturer is "well aware" of this fact.

MATS Short-Term Contracts Awarded

Call contracts totaling \$1,730,260.77 this month were awarded to nine airlines by Military Air Transport Service. Under the agreements, which are awarded periodically by MATS to meet the nation's short-term transport needs, the current list covers about 10,000 passengers and 500 tons of military cargo along Atlantic and Pacific coastlines under Decca facilities.

Contracts awarded on Feb. 5 and 6 last include public by MATS last week, were to the Flying Tiger Line, Inc., for \$115,917.47; Seaboard & Western Airlines, Inc., for \$134,654.16; Capital Airways, Inc., for \$28,756.62; United States Overseas Airlines, Inc., for \$209,532; Transair Central Airlines, Inc., for \$165,525; Overseas National Airways, Inc., for \$113,002; Los Angeles Air Services, Inc., for \$11,100; Titan Airways, Inc., for \$99,584.80; and Trans World Airlines, Inc., for \$11,085.80.



FAA Tests Bell Aircraft Landing System

Federal Aviation Agency Douglas C-47 laboratory aircraft is tested automatically through test facilities and procedures by all-weather landing system developed by the USAF at Bell Aircraft Corp.'s Avondale Division, being evaluated at National Aviation Facilities Experimental Center, Atlantic City, N. J., now open to track airplane and radio to transmit control instructions to aircraft's automatic pilot.

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West Indies Status May Affect Routes

By William H. Gregory

Decision status for the West Indies Federation and independence for British West Indian Airways which are likely to come in 15 months or two years now being with them some changes in airline route patterns in the Caribbean. Independence of the airline, whose shares now are 100% owned by British Overseas Airways Corp., depends not only on the attainment of dominion status in the Federation but also on whether the Federation will be willing to acquire the airline from BOAC for operation as a national carrier.

Despite some hesitating among the islands—especially from Jamaica is the largest in terms of population—U.S. government and airline sources believe the Federation will become a dominion in the British Commonwealth and that it will put up the capital to make the airline West Indies owned.

Underwriting this belief is the search by British West Indian Airways for an opponent. Negotiations, 15-month delivery is an important element in the order.

H. O. S. Wooding, BWIA chairman, recently finished a tour of West Coast manufacturers. Other officials of the airline are continuing negotiations. A decision is expected in the next two months.

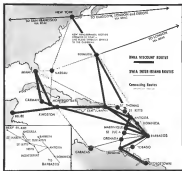
Transportation capability for the airline's Jamaica-New York-London route (not yet being operated) is uncertain, although a long-range jet transport would not be required for Caribbean-U.S. routes. The Conquest 680 was reported to land in each stage of the studies (AW Jan. 4, p. 34).

British opposition also is being considered, but the order is almost certain to go to the U.S. Leasing delivery dates for long-range British jets is the prime reason.

Leased transports might be used in the meantime on BWIA's other routes to New York—perhaps Douglas DC-7s in British possession. This route is now flown by BWIA's Vickers Viscount 780s from Trinidad and Barbados to Bermuda. From Bermuda to New York, the route is flown in a BOAC flight funded as a charter of BWIA's equipment.

The Federation, looking toward its future status, has been supportive of its request to sit on the U.S.-United Kingdom bilateral talks which began in Barbados this week.

U.S. airline sources are not so much concerned that the U.S. will face an direct conflict in the Caribbean. But there is some fear that there may be a repetition of previous cases where the



BRITISH WEST INDIAN AIRWAYS Yarnmouth routes and Douglas DC-8 routes (left hand) are supplemented by de Havilland Herons operated by Leeward Island Air Transport, a subsidiary, to island with island too small for the larger aircraft.

U.S. has traded with Britain for rights in British possessions and then tried to trade all over again for the same rights when the former refused to attend independent status.

Wooding told Air Access West that he personally would like to see a BWIA route into Mexico City where a link could be made with a U.S. carrier such as Western Air Lines. Officers he would not discuss what route plans the airline might be officially formulating.

Reapportionment undoubtedly will be a sensitive point with BWIA. Two cases in point are cited by BWIA officials:

• **KLM Royal Dutch Airlines** is a product of BWIA's view of the principal competitors of the 15 airlines serving various islands in the Caribbean. Yet BWIA does not have routes to the Dutch islands of Aruba and Curaçao in the Caribbean for links to the home country.

• **Trans-Canada Air Lines** serves Jamaica, Antigua, Barbados and Trinidad from both Toronto and Montreal. BWIA's Trans-Canada traffic rights into Montreal are agreed mainly to the British. But Toronto, BWIA contends, generates 80% of Canadian traffic into the West Indies.

Canada is interested in the West

Indies and more than a year ago was negotiating with Trans-Canada Air Lines and BWIA. The plan formulated over an hour reported to the islands. TCA wanted to consolidate all passenger air at Montreal, which would have meant closing BWIA's main base at Port of Spain, Trinidad, and the loss of jobs held by West Indians.

Canada's acceptance potential for future trade in the area, however, and those two are likely. Most cases in the Caribbean all the way from San Pedro and San Zedrair now because of Empire trade agreements. Canada needs West Indian routes to connect with other major air lines and has little more than a right to the islands. Another source of possible new traffic for BWIA is located, the one that goes into aluminum. Besides its position in Jamaica within the Federation, there are major supplies in British Guyana, French Guiana, Georgetown, British Guiana and operators British Overseas Airways for the British Guyana government.

Because of its geographic position the Federation has some natural advantages in its struggle for handling all flights between North and South America. BWIA is captured in the South American market, but has been cautious on carrying it up to one with the dis-

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With its rear loading ramp and unobstructed payload compartment, this helicopter has the ability to airlift a complete Little John system and crew, laying fire on a target 60 miles away 35 minutes after receipt of orders.

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Airline Traffic—Calendar Year, 1959

	Revenue Passenger-Km	Revenue Passenger-Miles (RPM)	Load Factor %	M.E. Hwt Ton-Miles	Revenue Ton-Miles	Flight Ton-Miles	Total Revenue Ton-Miles	% Revenue Available to Passengers
AMERICAN TRIM								
Atlanta	7,987,150	3,419,349	76.4	27,341,345	10,508,444	10,509,779	19,018,223	40.0
Boston	5,123,098	1,961,422	66.0	6,178,122	3,164,754	7,952,167	10,716,921	46.0
Capital	1,027,000	1,124,330	66.0	4,930,422	3,705,399	4,444,444	10,249,778	21.0
Chicago	1,187,500	476,539	24.9	1,589,192	835,707	2,444,444	4,179,153	42.0
Dallas	7,908,791	1,509,129	37.1	3,001,341	3,278,632	13,024,523	17,303,155	21.0
Denver	1,780,749	4,446,127	80.0	3,446,127	6,160,791	17,045,631	23,652,451	49.0
Detroit	1,764,430	1,112,431	30.0	3,446,127	6,160,791	17,045,631	23,652,451	49.0
Los Angeles	1,008,771	331,047	66.0	1,337,491	477,523	1,312,123	18,474,697	41.0
Newark	1,407,437	2,272,047	59.0	2,272,047	3,213,446	10,000,000	15,485,593	39.0
New York	1,026,816	4,876,431	70.0	3,709,869	6,942,765	16,700,000	25,342,595	39.0
San Francisco	7,942,817	4,874,041	40.0	3,181,744	11,077,093	16,700,000	30,814,034	29.0
Seattle	1,143,417	977,000	66.0	2,393,227	2,581,263	2,544,126	14,449,660	21.0
BETTERFLY DRILL								
Albuquerque	116,817	177,943	60.0	117,200	6,324,452	14,449,660	20,774,112	59.0
Albany	48,734	91,121	60.0	348,709	1,361,349	11,448,001	12,809,350	47.0
Albuquerque Affiliates	326,721	32,273	66.0	97,754	39,923	3,243,504	3,381,181	29.0
Albuquerque	60,800	47,431	66.0	97,754	39,923	3,243,504	3,381,181	29.0
Albuquerque	417,000	605,100	66.0	7,003,746	1,631,140	6,549,860	12,191,020	29.0
Albuquerque	137,720	33,100	66.0	97,754	39,923	3,243,504	3,381,181	29.0
Albuquerque	77,021	31,100	66.0	97,754	39,923	3,243,504	3,381,181	29.0
Albuquerque	146,624	334,700	66.0	16,700,248	246,128	11,651,589	44,195,404	49.0
Albuquerque	11,086	37,700	66.0	411,936	1,812,012	7,814,127	9,037,065	59.0
Albuquerque	334,151	1,779,349	79.0	16,947,229	24,601,253	116,194,839	157,743,391	83.0
Albuquerque	124,156	479,100	66.0	3,446,127	6,160,791	17,045,631	23,652,451	49.0
Albuquerque	225,700	1,281,111	77.0	17,146,108	34,172,779	116,194,839	157,743,391	83.0
Albuquerque	331,433	163,450	66.0	8,441,832	2,631,450	17,146,108	23,652,451	49.0
Albuquerque	118	118	66.0	97,754	39,923	3,243,504	3,381,181	29.0
Albuquerque	94,709	120,712	66.0	3,446,127	6,160,791	17,045,631	23,652,451	49.0
Albuquerque	347,100	1,049,169	66.0	15,947,229	31,341,710	142,194,839	173,536,591	83.0
Albuquerque	111,700	284,171	71.0	1,163,700	34,172,779	116,194,839	157,743,391	83.0
Albuquerque	91,429	37,110	44.0	179,118	200,281	9,028,112	9,227,431	44.0
LOCAL SERVICE								
Albuquerque	341,649	19,478	49.0	144,272	266,176	198,091	12,170,186	44.0
Albuquerque	121,754	66,444	66.0	66,444	28,912	128,700	3,444,444	29.0
Albuquerque	164,820	50,444	27.0	97,754	39,923			
Albuquerque	234,476	79,364	34.0	283,520	10,444	21,809	2,779,660	66.0
Albuquerque	126,107	116	66.0	97,754	39,923			
Albuquerque	201,240	121,842	66.0	147,215	39,923	177,000	3,770,771	66.0
Albuquerque	171,216	191,833	44.76	47,237	16,416	310,804	16,378,574	49.70
Albuquerque	126,107	116	66.0	118,118	39,923	16,416	16,416	49.70
Albuquerque	691,226	126,076	66.0	174,889	28,226	97,024	16,323,403	66.0
Albuquerque	691,226	126,076	66.0	174,889	28,226	97,024	16,323,403	66.0
Albuquerque	121,229	126,076	66.0	174,889	28,226	97,024	16,323,403	66.0
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Albuquerque	121,229	126,076	66.0	174,889	28,226	97,024	16,323,403	66.0
Albuquerque	121,229	126,076	66.0	174,889	28,226	97,024	16,323,403	66.0
Albuquerque								

Corrected by Aviation Week from earlier reports to the 2011 Assessment Board



WHAT WAS REMBER DOING AT PORT WASHINGTON? As this important U. S. Naval Training Device Center, the Navy is solving a basic problem in today's design engineering: how to accommodate complex electronic equipment to the performance capabilities of a human operator. Human engineering specialists of the Rember Military Products Division worked with Navy research teams to develop fundamental design principles for electronic equipment. The aim: practical maintainability by the average technician. The result was a manual titled *Maintainability: A Guide to the Design of Electronic Equipment*. A division of The Rember Manufacturing Company, RMPD is composed of Rember-Productec, David Manufacturing Company and HIR-SAGE.

A manufacturing brochure describing BMD's engineering and production facilities is yours for the asking.

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ARTIST'S conception of Atlas underground sites shows elevated launch area, maintenance and loading operations (left) and the KCRD control room (right). Construction is completed at elevated underground control room. Concrete is reinforcing in above-ground mockup.



USAF Plans Six Hardened Atlas Sites

Los Angeles—Hardened, underground silo launchings will be constructed by the Air Force for six of the 15 Comair Atlas intercontinental ballistic missile squadrons now planned.

The Atlas mounted vertically in the new designed silo can be fired in less than 10 min. after warning of an enemy attack with only a minute or so required above ground for engine start. The silo is a 15-ft diameter tube, approaching 70 feet for the Atlas in its vertical launch when the missile must be moved into an exposed vertical position above ground for propellant loading, final checkout and firing.

Vulnerability of the underground-launch Atlas is compared with those in soft sites which will be greatly reduced by the

silo's heavy concrete and steel construction and in placing the missile in a shock resistant cradle to protect it against all ground vibrations that are not strong enough to collapse the site.

Cryogenic Tanks

The cradle will be made of steel girders and isolated from the site by a network of springs. In addition to the Atlas the cradle will house and protect the on-gas tanks for storing the liquid oxygen oxidizer and the elevator mechanism for moving the missile to ground level. The elevator and liquid oxygen tankage are located in the lower 60 ft of the 145-ft deep-shock-proof tub.

Improvement in combat firing time in soft sites will be gained partially

through storage of the RP-4 fuel in liquid-ready condition in the missile's tanks and partially through the use of Amerscan Bosch Anna Corp.'s automatic guidance system which it simplifies its guidance on a ready base than the early radio-inertial system. Missile launch under tactical conditions will differ from the action hand-developments: Atlas launch in that the missile will not be held down until the ground reaches their peak threat in an open operation. The missile will lift off the pad in some as possible to keep the exposure time above ground as short as possible.

Full scale mockup of an underground Atlas launching complex is now being constructed behind the Convair-Astronautics plant at San Diego. The shock-

proof cradle has been divided into two parts to facilitate its construction above ground.

One part will contain the cradle, housing and servicing section, such as vent clock speed work, levels to fresh air, maintenance. The other part of the mockup will allow positive placement of the elevator equipment, liquid oxygen groups and loading, but free access into construction is easier.

Firing control center for each Atlas site will be located in a spherical underground room located a short distance away and insulated to be a tunnel. No antenna system will have to be exposed above ground during the launch and escape burning portion of the Atlas flight from a hardened site. Construction costs for a squadron at one of these sites and underground control rooms is estimated at \$44 million. The silo will be located a little more than two miles apart; the actual distance depending upon the base of ground in which they are placed. Construction expenditures for a soft-based Atlas squadron average about \$32 million.

In these sites, the missiles will be kept in a horizontal position or held up that will take very little man over pressure, than they would require in a launch.

Revised sites also are planned for the Atlas in which the buildings of the soft sites eventually have been placed below ground or have had large amounts of protective earth placed around them. Both the soft and hard bases have the disadvantage that the

missile must be exposed vertically for several minutes prior to launch, and a high wind could be sufficient to topple them over. Construction costs for the hardened squadron installation is approximately \$75 million.

Silo Locations

Six squadron locations for the hardened Atlas are now planned: Midland AFB, Texas; Keesler AFB, Mississippi; Mather AFB, California; Minot AFB, North Dakota; Omaha AFB, Nebraska; and Warren AFB, Missouri. Other squadrons located here have been referred to the standard Atlas launch facilities. At the Air Force, with which construction has begun, Tulsa AFB, Oklahoma; Keesler AFB, Mississippi; and Warren AFB, Missouri. While missiles designed in these sites hard sites will have a directed guideway system.

Three soft squadrons are planned: two at Warner AFB and one at Offutt AFB, Nebraska. Construction has begun at all three squadrons sites.

One Atlas squadron also is planned for Vandenberg AFB, California; construction has begun on launching installations which resemble the type and design developed testing launch pads at a service by a large gassy cone that rises the missile to an upright position after a warning so that it can be loaded with propellant. After the necessary checkouts, the gassy cone is moved back for firing.

Under major Defense Department plans, only Atlas squadrons were planned. The first two squadrons added to the program are all in hard sites, and

two of the present hard squadrons were converted from standard sites.

Estimated construction costs of a hardened Atlas squadron installation are from \$45 to \$60 million depending upon whether the control room can stand more than 100 miles in one in the probable location.

Scoutage Air Command squadron today includes one missile in reserve in addition to the one in silo.

NAA Designs Rocket Engines for Aircraft

Crozier Park, Calif.—Winds of wind propulsion rocket engines designed to boost aircraft performance has been developed by Rocketdyne Division of North American Aviation during a five-year Navy program.

The group consists of four series: AR-1, AR-2, AR-3 and AR-4. All are the aircraft's IP type fuel and 90% are being produced, as an engine, AR-1 direct to 5,400 lb. AR-2 series has thrust control over 50% of its thrust range from 3,000 lb. to 6,000 lb. AR-3 is rated at 5,000 lb. thrust at 75,000 ft. with thrusts varied over 57,000 lb. in three stages. AR-4 is 12,000 lb. thrust engine with thrust control over 30% of its thrust range.

AR-1 engine test box is in NAA's North American 11-4 at Palmdale Race and at NAA's Columbia Division about two years ago (NAV Mar 18, 1955, p. 24).

Palmdale series of flight tests on the AR-2 engine was completed in



Axusa Mk. II System at Cape Canaveral Nears Operational Status

Axusa Mk. II missile testing facility at Air Force Missile Test Center, Fla., is on the south end of Cape Canaveral. Part of the Axusa (NAV Feb 9, 1955, p. 61) antenna field is shown. The ML 30 antenna is expected to be operational soon; intermediate is finished and the facility is being checked out before acceptance. System comprises a field of 30 antennas and support equipment. The ML 30 system is designed to receive missile flight position up to one-third of a foot at distances to hundreds of miles downrange.

Harness the sun to make a spaceplatform run?

*We've a
good mind
to do it at*



ALLISON

DIVISION OF GENERAL MOTORS INDIANAPOLIS INDIANA

*Imagine an engine that can run unattended
for years on solar, nuclear, or chemical fuel . . .*

*An engine smaller than an office typewriter, yet capable of producing
3000 watts of electric power . . .*

*A vibration-free, virtually noiseless engine whose design makes possible
large-scale solar power systems.*

Such a power plant—the Stirling-cycle engine—has a brake thermal efficiency of 36% operating in space environments, 40% in surface operations with conventional hydrocarbon fuels, higher efficiencies when nuclear energy is used.

It's being built by Allison in cooperation with General Motors Research and the N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland, who initiated the modern development of the 145-year-old engine.

Currently, Allison researchers, scientists and engineers are working under an Air Force contract to develop this engine for use as an earth satellite power plant. Other potential applications include portable or stand-by power packs.

And this is but one of the many space-age projects we're putting our minds to at Allison. Scientific, engineering and production minds that make up the new look at Allison—minds backed by every resource General Motors possesses.

Whether your problem is concerned with the heavens, the earth, or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others—we could do it for you.

Illustrated is a segment of a lightweight, highly efficient solar reflector developed by Allison for use with the Stirling-cycle engine.





HOW Blind Nuts SAVE MANHOURS ON THE DC-8



ENDING BLIND NUT

The Blind Nut was selected by cost-conscious Douglas engineers for use as a replace-in-place fastener in all exterior passenger doors and emergency exit jacks of the cabin-pressurized DC-8 luxury airliner because of its simplicity and faster installation.

Each Blind Nut is installed in a single blow, in one operation and at a rate of about one per minute compared to two additional conventional holes required for the installation of two rivets to attach each nutplate.

Considering that each door on the DC-8 has several hundred or more Blind Nuts, a substantial number of manhours will be saved on each production airplane when compared to the additional drilling and reworking now required to install conventional nutplates.

Stainless steel Blind Nuts are being used on aircraft and marine applications up to 500° F. in production and repair applications. They are quickly installed with a break-held, hydrostatically actuated gun. Blind Nuts are available in grip lengths of 1/16" increments and range in tensile stress from 4-40 through 3,000-24.

Write for additional Blind Nut data

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Month, with the cargo door closed at thrusts ranging from 2,000 lb to 7,000 lb—1,000 lb. above and below its design performance ratings.

The model of the engine, designated AR-2, is now in order in new flight test phase as an F-56 fighter. The AR-2 is being developed for both blower installation on F-56 type aircraft to expand its speed and thrust ratings. Sides for jets are the N-110 and DC-110 variants which were specially large numbers of F-56s. Japan reportedly is interested in the program.

AR-2 uses engine data fed from thrust signal transducer and propellers can be generated or bypassed by thrust chamber. The turbocharged engine can supply up to four thrust chambers in a cluster.

Turbopump system on the AR-2, which is based on AR-1 and AR-2 as well as the turbocharged pump rack for fuel and oxidizers both driven from a common shaft and use gas generator. Three per cent of oxidizer flow from the pump is diverted through the thrust control valve into a control in the gas generator where it becomes supercritical steam to drive the turbine for the two pumps. Pumps, gas generator and other engine auxiliary equipment are mounted around the thrust chamber to keep the installation as small as possible.

Thrust is controlled in pumped engine by metering oxidizer flow into the gas generator to control turbopump output and propellant flow rates.

Cluster pressure which are 180 psi for AR-1 and AR-2, and 250 psi for AR-4, are sealed and maintained to keep thrust at desired level. Pressure lost oxidizer flow fed from the turbo pump outlet passed through a chamber pressure actuated fuel metering valve, flow through the fuel injector into the chamber. Oxidizer is injected through the thrust chamber cooling system as the AR-2 engine, and through the turbine with AR-1 and AR-2 engines which send some representative cooling at five higher thrust levels. After performing the cooling function, the oxidizer gases through a turbine series before entering the thrust chamber together. The oxidizer enters thrust chamber as an oxygen-rich mixture and supercritical steam at 1,500° F.

Shooting sequence is completely automatic for the engine, and an ignition system is required. Oxidizer, with its oxygen reduction and supercritical steam, enters the combustion chamber before the fuel, and combustion occurs when the fuel is injected. Shutdown is a automatic if igniting fails or an engine fails. All engines have an abort or abort.

Price drops are an oxidizer generator, gas feed and oxidizer pump/gas, jet exit and thrust pump and wiring, liquid

AMC Contracts

Wright-Patterson AFB, Ohio—A list of evaluated contractors for \$25,000 and over is released by the Air Material Command.

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AVIONICS

Ultraviolet May Have Space Signal Value

By Barry Miller

Piscataway, N. J.—Ultraviolet waves show considerable value for signaling between the earth-or in earth orbit—and space vehicles in planetary distances, according to Dr. Gerald E. Ellis, a senior scientist on the staff of the GPR, Division of General Physics, Inc.

Ellis has been studying the communications potential in optical wavelengths below one micron in the near infrared to the past 100 microns. After extensive calculations, he concludes that the 400 to 2,000 angstrom action in the ultraviolet band is the best optical signal for communications with existing equipment between earth satellites and space vehicles near Mars.

Similarly he sees, 3,000 to 4,000 angstrom would prove an optimum selection of the transmitting sensor was located on earth rather than in an earth satellite.

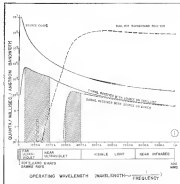
General Physics is one of a growing list of firms becoming interested in the feasibility of space communications as space races throughout the optical spectrum (AW Dec. 14 p. 37). That list comprises an array of companies with optical, infrared and acoustic capabilities. It includes, besides General Physics, Technical Research Group, Inc., Hartford, Conn.; General Optical Co., Inc., Electro-Optical Systems, Inc., Sunnyvale, Calif.; Sperry Gyroscope Co.; Eldec Laboratories; and Avco Division of American Rocket Areas Corp., all backed up by other groups working on related devices and phenomena.

Government Support

Government agencies are supporting some work, other contracts are in the offing. One firm, Electro-Optical Systems, has a \$407,334 contract from Wright Air Development Division for an experimental communication system using deflected sunlight devices with out windows in electron crimp and making it the relay system source for direct communication.

Most of the work in optical frequencies is done by electronic hardware in highly theoretical or exploratory. While different portions of what is broadly referred to as the optical spectrum—the sun from the near infrared down to the hard X-ray and gamma ray spectrum appear promising, only further study and experimental work will reveal what their ultimate value will be.

One such source does, however, have studies like Ellis'. Optical com-



SHADED PORTIONS under signal strength curves indicate most desirable wavelengths or frequency selection for earth-to-space and space-to-earth communications. Areas in shaded portions of the earth. Faded areas are areas used in calculations. Areas in shaded portions of the earth. Faded areas are areas used in calculations. Areas in shaded portions of the earth. Faded areas are areas used in calculations.

munications offer valuable, and distinct advantages—secure, jam-free, long-distance transmission for military use, and an extension for space studies of the available portion of the earth's over-coverage spectrum.

Currently, GPR is seeking Air Force funding to continue Ellis' studies in the optical region but the company, having spent heavy sums in the infrared, microwave, and gamma ray, as well as communications, will continue to advance this work in the absence of government backing.

Design Problems

Ellis considered the optical spectrum from one micron in the near infrared (at 300 nm in frequency) through the visible, near ultraviolet, far ultraviolet and hard X-ray and gamma ray spectrum. He studied the overall parameters for a system with transmitters on earth, or in earth orbit, and the

receiver in a space vehicle near Mars when the planet is at the far side of its orbit—a distance as great as 210 million miles.

Receiving System

For the receiving system, he estimates that the optical vehicle can carry a 20 ft diameter collector mirror which would focus the collected radiation into a glass-and-optical cell, in a photomultiplier, the former for ultraviolet or visible radiation, the latter for infrared. If X-ray radiation was used, a scintillator counter could be the detector. Outputs from these devices can be amplified and then fed to the nearest device.

On the sending end, a possible source with a light source at its focus would be selected to maximize the amount of light focused into the receiving collector. In Ellis' calculations, a transmitter mirror with a focal length

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of 35 ft. and a diameter of 30 ft. was assumed.

Unless the source surface material is properly selected, some useful signal will be lost due to a drop-off in source surface reflectance in the far ultraviolet region. At 10,000 angstroms, for one, polished aluminum is 95% reflective and slightly less reflective at 2,000 angstroms, near the edge of the far ultraviolet region. In the far ultraviolet, germanium, another possible source material, is estimated to be only 45% reflective, a figure which drops to 20% at 400 angstroms. In fact, this area, the fall-off in reflectance in the basic materials in the carbon-coated-based system at the shorter wavelengths.

Besides choosing large sources, the designer can increase signal strength by boosting the light output. One method of producing a bright source, and the one selected by Mills for his study, is to pass high currents through fine wires, thereby producing high incandescence and high intensity sources. With this exploded wire technique, a 150,000K temperature probably can be reached to permit for use addressed although in exact proportion to unknown. The spectrum at a 12,000K exploded wire, however, can be made to approximate that of a black body.

Tined Flashes

With the exploded wire technique, a practical system can be designed to mechanically connect sources of fine wire to a metal parabolically shaped producing lined, perhaps solid, flukes at the transducer focus. In his calculations, Mills assumed one surface and light flash could be obtained from a 150,000K source. Other practical sources, such as high intensity arc gas discharges, the proposed optical flash and the sun itself might be used but were not included in this study.

Signal and background variables for optical communications to a spacecraft near Mars were calculated and plotted in the graph on p. 63 using



MODULATOR SCHEME The optical communications rate changes in speed and frequency of repetitive deflection under influence of electric field to control light passage through galvanometer.

the previously mentioned maximum. Separate parts of the graph are as follows:

- **Signal strength or source case**, which indicates the output of a spherical black body source of the diameter expected to be useful with a 10 ft. transmittance mirror. From right to left, this curve rises to a maximum near 50 angstroms, falls sharply in the soft X-ray region. It indicates the maximum signal source is available at short wavelengths by approaching the 50 angstrom limit.
- **Signal received with source on satellite case**, calculated with the source case and including the transmittance on source reflectance and the losses in

of the transmittance mirror. The drop off in the far ultraviolet is due to the poor reflectance at the very short wavelengths.

• **Signal received with source on earth case**, which includes the geometry correction for attenuation of optical source in the earth's atmosphere. Atmospheric transmission varies from 90% at 2000 nm in the near infrared, to approximately 91% in the visible region at 3,400 angstroms and drops to zero at 2,900 angstroms on the near blue violet.

• **Sunlight background received curve**, which represents the reflected sunlight from the earth, its clouds and its oceans.



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sized by a receiver collector member from its position near Miss.

The product of these errors and phase-shifted efficiency in an indication of the received signal, the total level is the square root of the number of excited phototubes operating with the background noise curve.

Signal-to-noise ratios were calculated and the highest found to be in the 2,000 to 450 angstrom region. These ratios are sufficient for making a signal at one bit per flash for beyond Miss. Moreover, if this added noise-to-signal distance was not needed, the severe impairment for this problem could be reduced.

When the noise is on earth, however, the signal-to-noise ratio is present in the 450 to 750 angstrom region but is insufficient to permit communication with Miss when the planet is at the far side of its orbit. This distance could be gapped. If this was under these conditions if the phototube-higher electrical signal was provided by accurate signal flashes for this distance at a sacrifice in the resolution rate.

The signal-to-noise ratio for a single flash from the earth transmitter is sufficient, however, for communication with Miss on its closest pass to earth a distance of roughly 30 million miles. Communication to the moon would be correspondingly exact, allowing its appreciable distance in space temperature.

X-Ray Regions

Soft and hard X-ray and gamma ray regions were considered and found to be unsatisfactory for the application because of unfavorable signal-to-noise ratios. Signaling is possible by utilizing the signal collection from several seconds or minutes per bit, but this would require power requirements per bit.

Ellis confirms that his calculations are based on equipment known to be available. New components, such as optical fibers which are now being built, could alter the desirability of using the wavelengths in the ultraviolet region. Optical fibers, naturally at sea rate, are not expected to operate much beyond the visible range.

Various modulation schemes, based on mechanical, electrical and optical properties, can be used in optical ray communication. An illustration of one such technique is the use of rotating mirrors in the use of electric fans to control passage of a light beam.

To modulate at megahertz frequencies, according to Ellis, a Kerr cell might be used effectively. This requires two parallel-polarized beams with one caused to block light passage. A modulator of a liquid such as nitrobenzene introduced between par-

X-Ray Space Communications Studied

William, Miss-X-ray and high-energy particles will be investigated here as possible means of space communication by Tinsdale Inc. under a \$750,000 contract from the Rome Air Development Center.

The company will study the feasibility of generating, modulating and detecting X-rays and high-energy particles for a communication system which would operate beyond the earth's atmosphere where absorption losses are expected to be negligible. Intelligence may be conveyed by X-rays in charged particles, such as electrons, at tremendous speeds across optical distances in space, the company's proposal to the Air Force claims not. Power requirements for an electron system, the proposal claims, might be comparable to those of a radio system and perhaps a factor of 100 to 1,000 times less than those of the X-ray system. Size and weight of generators and detectors of either system should not differ appreciably from those of radio equipment.

A severe limitation to the use of X-rays, however, is their inability to be focused, retroreflected, X-ray's actually disperse with the square of the distance from the source. X-ray use is prevented in dense bodies because of its great natural loss by a reflective source, but the constraints of distance along with X-ray's energy tends to be sufficient.

Accelerated electron beams might be used for communication at a considerable price, being because a beam can be electrostatically focused into a parabolic collimator, the company's proposal indicates. Generation of 3000 amp is possible. The electron source has an ion current discharge rate of a megampere per disturbance by electric or magnetic fields.

As in other radio communication techniques, modulation methods are a factor. Compression of modulated radio modulation, however, may be based on an high-capacity pulse system. AM and FM modulation methods are also possible. The former method might be less suitable because compression distorts other calculations of signal reception. In analogy with phase modulation could avoid distortion of signal reception of energy losses, substantially reduce the energy background. More complex methods of subsequent pattern of modulated and energy are also possible, according to Tinsdale.

Some of the solutions that Tinsdale proposes place on X-ray equipment would be more closed in space. This can be illustrated by a modulating system with a mirror. It might consist of a lightguide with a mirror which would be rotated by a laser beam of the proper length. A direct beam at the center of the lightguide would provide a mirror of electrons which would be accelerated to the lightguide surface. The operation would be similar to a conventional modulated X-ray beam. Because the input power would be dissipated over a large area, but this would be reflected back to allow generation 1,000 times the generation possible with a modulated X-ray beam, Tinsdale says.

Detectors for X-ray and electron could be sensitive channels which might be made very large in size. A light attenuated lightguide perhaps 100 ft. in diameter, might be used.

Final evaluation of these systems would require the weight, bulk, power input, cost, lifetime, reliability, modulating, reception, reflection and other factors. These would be compared with those of communication systems based on radio and light waves.

(b) plates to form a capacitor can be used to form a polarized beam.

When a generator applies an alternating field across the capacitor, the optical properties of the liquid change thus allowing the plane of polarization and polarization light passage at prescribed intervals.

Magnetic Analog

A magnetic analog of the Kerr effect is that that applying the linear effect, would replace the capacitor with a uniform iron garnet as a magnetic field. An investigation of the linear effect in garnet growth was in progress at GTRI.

Other modulating techniques in chalcogenide applications of the Pockel-

er effect might be possible. Ellis says.

Source through the optical range, light can be generated by applying d.c. electric fields to a liquid crystal or low frequency, ac can be applied through a transformer to a magnetic field. X-rays could be carried through electron beam modulation.

In the future, an optical solution is possible by the integration of optical fibers. For shorter ranges, Ellis points out, the source could consist of a small amount of low threshold radioactive material which could emit solution when a shutter is opened in the shielding. More sensitive sources can be obtained



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These easily detachable heads are available in various frame sizes, and supply reductions in ratios ranging from 7.2:1 to 42.4:1, 90:1. Built-in input are Class A, B, C, or better, and units are used in ASMA Precision II telescopes or lenses, with backlash held to 30 minutes, or better. Adaptable to variety of input and output gearings. Write for details.

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AIRBORNE portion of photo-transmission system is shown in artist's concept. Components are control box (1), junction box (2), magazine (3), camera body (4), lens case (5), clock antenna (6), receiver (7), transmitter (8), film cartridge ejector (9), processor (10) and deck box (11).



GROUND EQUIPMENT for photo-transmission system consists of solar dishes (1), power truck (2 and 11), AN/CPG-1 tracking radar (3), plotting board (4), receiver and signal generator truck (5), motor and antenna control dish (6), tracking antenna (7), ground station processor-transmitter (8), air conditioner (9), and support trailer (10).



GROUND SUPPORT equipment for photo-transmission system being checked by engineers includes (from center to right) radio receiver with display camera acquisition unit, direct view receiver and cooling unit, antenna control unit, and the receiver and power supply unit.

CBS Photo Recon

Standard, Com-Tect units of a high-resolution aerial photo reconnaissance system developed by CBS Laboratories have been delivered to an undisclosed military agency, according to a company spokesman.

The system can scan visual images obtained by so-called cameras and convert them into signals for transmission from an airborne vehicle to receive sites on ground receiving stations where the pictures can be reconstructed. Total time from aerial photographing to reproduction of film on the ground can be as little as 30 sec, CBS says.

Key element in the system is what is described as a compact CRT, known as a Laser Scan Tube.

ground stations, the television signals are reconstructed on a cathode ray tube to provide a rough picture. Higher resolution pictures (20 lines/cm as 70 sec film) are produced by a ground receiver.

Airborne portion of the system, including the telescope transmitter, antenna, two-stage processor, modified KA-16 camera, receiver and controls will weigh about 120 lb. The communication equipment alone weighs 1,300 lb on a weight 83 lb.

The KA-16 is equipped with four interchangeable lens covers with focal lengths of 1.5, 3, 6 and 12 in., all better than 14.5. The lens is protected before vehicle takeoff.

Transmission bandwidth of the system is 1.5 mc with transmission on 225 Mac. Future versions of this system which are now being developed for reconnaissance will use the much allocated 4.4 Mac, to 5 Mac, and have 4.5 to 6 mc bandwidth, according to Fitzhugh.

The camera will be equipped with both enlargers for night operation. Future version of this tube are expected to handle infrared or video photos.

FILTER CENTER

► **Radar Duct Confirmed**—Features of a 500-ft.-diam radar duct, produced by trade wind temperature inversions, at a height of 5,000 ft. extending from West Alaska to the coast of Brazil, which permits propagation of VHF frequencies far beyond line-of-sight distances, has been confirmed by recent Naval Research Laboratory tests (AW Nov. 8, 1968, p. 23). Using frequency of 229 mc and a transmitter power of only 100 watts, signals were detected by Navy aircraft at distances of nearly 1,500 mi. at the duct altitude. Measurements confirmed predictions based

on meteorological studies made by Naval Research Laboratory, Air Force Cambridge Research Center and Electroscience Research Corp. Scientists predict that the radar duct should provide a stable, transoceanic medium throughout the year with only a small seasonal variation in height. Similar radar ducts are predicted for other trade wind areas North Atlantic and North and South Pacific. Future programs will investigate radar ducts between California and Hawaii, experienced by the American World Airways in its VHF ground-to-tropospheric scatter path (AW Jan. 16, p. 46) as well as methods for coupling radar energy into and out of the elevated duct from ground-based transmitters and receivers.

► **Engineer Enthusiast**—Despite continuing demand for engineers, fresh new engineering enrollment in 1969 was 35 below 1958 which in turn was down 15% from the previous year, according to the Federal Office of Education.

► **End to Ion Beam**—Dr. Leo Esaki, Japanese scientist who discovered the tunnel diode, will join International Business Machines Corp. in a research consultant in the company's silicon diode research department at Poughkeepsie, N. Y. The transfer, Esaki, diode is expected to find widespread use in digital computer circuits.

► **USAF Seeks Desirable Transistors**—Westinghouse Electric will develop processes and equipment for synthesis, production of desirably grown single crystal semiconductor materials under use. Air National Command contract USAF seeks to apply silicon technology to fabrication of low cost, reliable solid-conductor devices as well as to use USAF-sponsored monolithic program (AW Feb. 4, p. 70). Using newly developed chemical growing process, companies produce semiconductor crystals in the form of thin, narrow, highly polished ribbon eliminating need of the costly operation now required to cut a crystal into its end semiconductor device. Under ANCC contract, Westinghouse will use silicon and gallium arsenide materials. Company has recently developed techniques for growing a complete wafer conductor "sandwich" containing two junctions in the desired process.

► **Tips for Designers**—Application Notes for Military Receiver Tubes a Supplement to "Military Handbook, No. 11" Techniques for Application of Electron Tubes in Military Equipment, which goes beyond the handbook in dealing with common application problems, common, conventional or complex equipment, has been prepared

EXPERIENCE

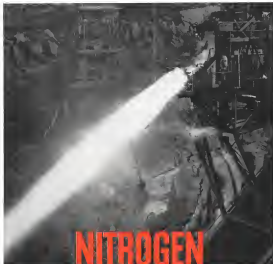
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COMPONENT KNOW-HOW

THE KEY TO SYSTEMS CAPABILITY

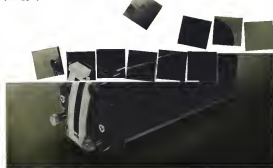


In systems development there is no substitute for experience in component and subsystem design. For more than five years, Daystrom Pacific has been providing gyroscopes, transducers and other basic building blocks for major airborne and missile systems. The development of equally reliable airborne instrument systems has further enhanced Daystrom Pacific's overall capability. Backed by its parent organization, Daystrom, Inc., the company has expanded its airborne instrument and subsystem work to include systems development programs that require the competency of an outstanding technical team... the thinking and shrewdness of an advanced planning group.

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attained wave figure of 0.6 db, gain of 30 db and operating frequencies up to 1 kmc was reported by M. Striffler, Institute of Technology, in Zurich, Switzerland. Superconducting rectifiers which pass up to 1,000 amp, but whose breakdown voltage is as yet undetermined has also been developed. Both are presently low power devices. Original work on wave devices, which started two years ago has now been supplanted by films.

► **Radio Diode**—Enthousiastic Probing-Cousson, among engineers who have been designing radio or tunnel diodes into experimental circuits is that in theories for the new diodes has hit their pitch in just few months and will soon put a question of diodes and more thorough for them will pass them, problems. Ultimately, these engineers agree, may lead down to end — if the diodes can be made and sold through enough technical problems can be lifted.

► **Thin-Film Memory**—Witch for demonstration of feasibility of small, dense thin film memory in Burrough Corp. at IBM Corporation of Nassau.

► **Microminiaturization Programs**—Rush of new microminiaturization programs will be introduced to various industries in forthcoming months. Silicon is set to increase its role, and far to change the semiconductor program previously supported by Aero-Signal Corp. Fairchild Semiconductor to offer solid "monolithic elements"—complete semiconductor logic circuits packaged in single transistor hermetic to industry this year. Other programs under way at Lockheed, General Electric in Syracuse and Bell Telephone Laboratories in Whiggam.

► **Inductance Diode**—Superconductors in inductance diode which has potentially large inductance and high Q was described in a report by J. Nakamura and Y. Watanabe of Research Institute of Electrical Communication, Tohoku University, Sendai, Japan.

► **Tunnel Diode Traveling Wave Amplifier**—Potentially broadband, isolated traveling wave amplifier was reported recently at Bell Telephone Laboratories. First made wave diodes 9 db peak gain at frequencies above 1 kmc from a row of four germanium tunnel diodes in a very-low-loss, grade. Device was tested at a bandwidth of 200 to 300 mc, according to Morris E. Hays who designed device with William W. Anderson at Bell Telephone Laboratories.

From Stratost...

NEW MISSILE AIR CONDITIONER for ground support



HIGH CAPACITY • LIGHT WEIGHT • VAPOR CYCLE

This new ground support air conditioning package by Stratos provides a cooling capacity of 30,000 BTU-hour when equipped with an 8 hp 7,500 rpm motor compressor unit, and 50,000 BTU-hour with a 12 hp 11,500 rpm unit. Weighing only 350 pounds complete, measuring just 40" x 24" x 20", and rated at 3-3/4 to 4-1/2 tons, this Model VERA-3 air conditioner simply demonstrates the high capacity that can be achieved in a compact package — due to Stratos' unique Ref-Rely compressor and efficient evaporator and condenser. This rugged VERA-3 unit meets military specifications.

Specifications:

Conditioned air flow	30-60 ft/min.
Output Temperature	Automatically controlled 60° to 80° F ±2°
Weight	350 pounds complete with controls, charge and controls
Refrigerant Capacity	22,000 BTU/hr (11 lbs)
Refrigerant System	208 or 415 V-3 phase, 400 cycle, 4 wire
Cooling Capacity	30,000 or 50,000 BTU/hr
Controls	Remote panel, cable connected
Ref-Rely	Refrigerant 12

STRATOS

A DIVISION OF DAYSTROM ENGINE & AIRPLANE CORPORATION

Bay Shore L. I., N. Y.

HRB-Singer Infrared Recon Photographs May Have Anti-Sub Warfare Application

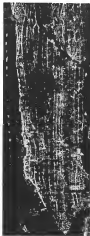
Significant improvement in infrared reconnaissance state-of-the-art since the early 1950s is pointed up by infrared photographs now released by Department of Defense. Aerial photo made at Manhattan Island (left) from an altitude of 4,000 ft. at 11 p.m. with an infrared Reconoscope system developed by HRB-Singer, Inc., subsidiary of Singer Manufacturing Co., shows high definition and resolution comparable to early 1950s, when the photo was made.

Electronic photography with three high temperature bodies that act like beacons, appearing as intense spots of light. Ships in the Hudson River also are clearly visible, in the Town-Singer view. Equipment can detect slight differences in temperature between water alongside the ship and water temperature in the wake, indicating direction of vessel movement. This suggests possible application of infrared reconnaissance for anti-submarine warfare.

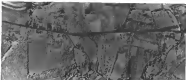
The HRB-Singer infrared reconnaissance system, developed under sponsorship of Wright Air Development Division's Aerial Reconnaissance Laboratory and the Army Signal Corps, is an infrared adaptation of an earlier visible light recon system developed by the company. Infrared photo is produced on a moving-strip film whose speed is varied as a function of aircraft/ship speed over the ground.

If advance rapid-processing of film is incorporated in the system, and a radio data link transceiver is added, the infrared reconnaissance photos can be transmitted to ground stations within a few seconds after photo has been made. This application of infrared system conceals it under development for use by Army for battlefield reconnaissance.

HRB-Singer is actively engaged in development of both infrared and electronic anti-submarine techniques and systems. The latter includes signal-sum radio frequency analysis and communications detection techniques.



Manhattan Island as seen by infrared reconnaissance system developed in the early 1950s by Singer Corp. of America, which showed infrared recon potential.



First infrared photo made by HRB-Singer Reconoscope in 1950 shows fringed from an altitude of 1,000 ft., taken at 5 p.m. System used a lead sulfide infrared detector, which was an outgrowth of a photo reconnaissance system developed earlier by HRB-Singer.

Metallurgical Memo from General Electric

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GRUMMAN hydrofoil concept contains two struts on forward hull portion and a single submerged foil on the stern.

Major Aviation Firms Survey Hydrofoil

By J.S. Betts, Jr.

Bedford, L. I.—Maritime Administration award of a hydrofoil boat development contract to a Grumman Aircraft Engineering Co. affiliate lays out a significant effort among major aircraft companies to move into this new ship-building field.

Grumman got into the field when its affiliate, Dynamic Development, Inc., was awarded a \$1.5 million fixed-price contract to deliver an 80-ton hydrofoil craft with a guaranteed 60 kt top speed by June, 1961 (AW Feb. 1, p. 48).

Several aircraft firms are now interested in a Navy competition for development of a 45 kt Patrol Craft, Hydrofoil (PCH). Bureau of Ships is scheduled to choose a contractor in the near future, and aircraft firms face tough competition from the shipbuilding industry which is pushing hard to get into this field as it begins to receive serious governmental support.

Other nearby companies include Grumman which are reported interested in the PCH competition are Lockheed Aircraft Corp., the Martin Co., North American Aviation and Boeing Airplane Co.

Maritime Administration is estimated that a large market for ocean-

going hydrofoil boats will develop of most immediately in the wake of the sea trials planned for the Grumman boat in the summer of 1963. General optimism surrounds the Maritime Administration-Dynamic Development project because extensive experience with many types of hydrofoil designs has accumulated since the last century, and extensive progress has been made since World War II.

Greatest amount of hydrofoil research probably has been conducted in the U. S., largely with Office of Naval Research support. Transit commercial hydrofoil boats were all made abroad, however, and they are used in relatively protected water, primarily in Switzerland, Italy and Russia.

Key Objectives

Key objectives of the current Maritime Administration project are:

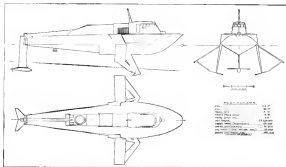
- **Cost-effective demonstration** that a large hydrofoil craft can operate in all weather, as has been indicated by research with smaller boats even though the hull will be in water in a small percentage of sea states. Success of the 80-ton boat is expected to pave the feasibility of hydrofoil craft from 180 tons and larger which can carry 500 or more passengers at speeds of better than 100 mph.

- **First use of aircraft turbine engines** on large hydrofoil craft, cutting the installed weight of the powerplant and its transmission system by a factor of about five.

The Grumman boat will be powered by a modified General Electric T79 turbojet designated the Model 240 with a free turbine which is take off about 98% of the engine in the exhaust stream to drive the propulsion system.

Shafting using two right-angle gear boxes will transmit a maximum of 14,250 shp from the free turbine wheel to a single super-overdrive propeller which will turn up to 4,000 rpm. Total weight of the powerplant installation and gearing will be less than 18,000 lb, and its use is radically smaller than respecting equipment of the same power. Ten Pratt & Whitney R7500 engines for instance, would be needed to provide equivalent power.

When the hydrofoil craft is operating as a displacement boat (for docking, low speed harbor run-ups and during high sea states), a 300 shp auxiliary turbine will be used for propulsion. This engine, a version of the General Electric T58, called Model 733, will provide single power for maneuvering the boat in the displacement condition thus avoiding the difficulties of using the T79 for this purpose.



RANGE of this vehicle design would be 600 miles at a design speed of 60 kt. Draft with foils up is 6 ft. 6 in.

Potential

Placement arrangements for the Maritime Administration project are a good indication of the confidence Grumman and General Electric have in the potential of the turbine-powered, sea-going hydrofoil. The \$1.5 million from the Maritime Administration will cover less than half the delivery cost of the boat, and Grumman and General Electric are supplying the balance. General Electric Civil Division in Lynn, Mass., is providing the shafting and gear boxes.

Hydrofoils used on the boat are basically the same ones that were developed and patented by William F. Carl and the company he founded, Dynamic Development, Inc. Grumman acquired a 50% interest in Dynamic Development in 1956. These hydrofoils are the surface-piercing type, and they were used on the Office of Naval Research YC-114 hydrofoil test boat by Carl which could run at sustained speeds of more than 90 mph.

The Carl design uses two main sets of surface-piercing hydrofoils ahead of the boat's center of gravity, with a single completely submerged foil on the stern supported by two vertical struts. The forward foils will carry about 80% of the boat's weight.

Submerging foils will be used on the Maritime Administration boat, and it is expected that they will keep the



MODELS depict two forms of hydrofoil, model below has super-overdrive propellers.



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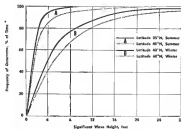
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GRAPH shows varying frequencies of waves in the Atlantic Ocean in summer and winter.

typ speed under 30 kt. A large bubble of water vapor forms a cavity on the top surface of the hydrofoil in the lead pressure drops down to the vapor gas zone of the water. On sub-cooling foils, this cavity forms and collapses at a high frequency and will strike and shake the foil. This action limits the speed of this type of hydrofoil. The surface-piercing foil design usually delays the onset of vibration because air blocks down the foil and only in keeping the cavity of water vapor stable.

Cavitation Solutions

The cavitation problem has been overcome in small quantities with the development of the super-cooling hydrofoil. At high speeds, the geometry of the foil produces stabilizing pressure in the upper surface water vapor cavity so that the cavity remains forward and does not periodically collapse. Boat speeds up to 200 mph are believed possible with this class of foil.

The super-cooling foil is shaped much like the blunt-but sharp leading edge designs which have been used on aircraft that fly well above the speed of sound. Sub-cooling hydrofoils resemble submarine carhulls with rounded leading edges and sharp trailing edges.

The Maritime Administration boat will be stressed for speeds above 100 mph so it can be used to test a super-cooling foil system at the money because available to test one. A large amount of excess power is also available for higher speed research since only about 10,000 shp will be required using the sub-cooling foil system at 30 kt., well above that much more will available from the [79]

Ultimate hydrofoil system, in the opinion of most marine engineers and hydrodynamicists, will consist of fully

keep the submerged foil system stable has been under development for some years. It was some type of submarine or other jacking unit on the bow to feed a description of the waves just ahead of the boat into the autopilot so the movement of the foil can be adjusted to maintain level flight as wave height and direction of flow change. Adequate autopilots and submerged foil systems are believed to be available as soon as they are called for by the navy or commercial firms.

One of the big contractors surrounding the current Maritime Administration and Navy PCIB hydrofoil boats is hull design. There are two main schools of thought, with one contending that the hull should be built like a supersonic bottom and the other holding that it should be built like a destroyer.

Lead Transmission

The advantages of the supersonic type construction in high strength-to-weight ratio, which is so important to vehicles supported by hydrofoil is it is those supported by wings, and the ability to take high impact loads that normal boat bottoms are not designed to take. The "V" bottom of a supersonic hull with its high dead rise angle, transmits a small load to the rest of the hull when it plows suddenly into a heavy sea in comparison with the load transmitted by the relatively flat bottom of the destroyer. As a consequence, destroyers and other small vessels have to slow down in heavy seas due to the pounding on their bottoms when they pass through waves.

One of the arguments for the destroyer-type hull is that it has better sea-keeping characteristics, which will be useful during the tests that the



GRUMMAN'S 100-kt-capability hydrodynamic test facilities are in use for foil tests.



GAS LUBRICATION

Research in gas lubrication and on performance and application of gas bearings is an important current activity at Jet Propulsion Laboratory.

The photographs shown are actual visualizations of gas flow patterns (obtained by an ultraviolet fluorescence technique) on a shaft under varying loads. Those on the left show pattern on an unloaded bearing—those on the right when

bearing is loaded under 80 lbs. at 40 psig supply pressure.

These research experiments relate directly to the use of frictionless bearings in space vehicle components.

This is another example of the variety of supporting research and development being carried on at JPL to advance the national space exploration program.



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SUPER-CAVITATING propeller is under development for Navy.



FOIL shape is placed in test facility for water shock study.

you are so rough that the hydrofoil cannot get up on its foil and must be used in a displacement hull. This is answered by the proposals of the so-called type hull by the theoretical stability of the hydrofoil hull when its foil system is completely submerged into the water. The hydrofoil hulls have proved to be just as effective as grossly overbuilt conventional hulls in grossly overbuilt conventional hulls in grossly overbuilt conventional hulls.

The hull of the Maersk Adriatic, a new hydrofoil hull will have a simple bottom complete with step and high dead rise angle. In addition, all-steel construction will be of aircraft style sheet metal design using relatively closely spaced frames and stringers to take the high density lateral loading situation common to hulls.

It will be stressed to hit a wave at max. 100 ft. in the event that one of the hulls should miss.

Water propellers of the super-cavitating type will probably be used on all heavy hydrofoil hulls. Air propellers are considered more advantageous for lightly loaded hulls.

Large numbers of hydrofoil craft were designed and evaluated during World War II by German army and navy, Hans von Schmol, now associated with a Swiss hydrofoil firm, Supramar AG, was active in the program. The boats ranged between 4 and 65 tons and reached speeds up to 100 kt.

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to load either passengers or cargo, it will come shut again in a reliable and that keeps its original properties and holds cabin pressure.

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AGE-PROOF Jet's conception of the B-70 Valkyrie is the first official view of the March 1 bomber and confirms indications revealed by *Airpower* Work unit in the Dec. 7, 1959, issue (p. 24), showing a Dynaflex turbine. Prototyping was cut to \$75 million for construction of two prototypes, with some systems still open to review (AW Jan. 27, p. 28).

explode could flow with the door open. For an age, seals would contain the capsule for more than 72 hr. In a storm sea, the capsule would float down. A popping valve entrance would prevent for crewmen to transmit distress signals. If ripped, the capsule has buoyancy and stability to right itself.

A demonstration of the encapsulated test was performed here by Al White, North American's chief test pilot for the B-70 program. For several test runs, White sat well forward of the capsule perimeter, with complete freedom for arms and legs. With the pull of a lever, the test record rapidly off and clamped closed, in effect putting White in a sealed pressure vessel. In this position, the occupant could trigger the mechanism and eject the capsule, leaving him to about 15,000 ft. In about three months, when the rescue chute would be deployed, ejection of the capsule could be from as high as 50,000 ft, it was declared, indicating its potential for use with space vehicles after launch or during re-entry.

The seat also is compatible for operation from maneuvers at speeds of 70 to 90 ft.

Encapsulated operational highlights of the B-70 were outlined by Program Manager J. J. (Bud) Jones. Cost for the first B-70 operational wing comprising 60 planes—50 basic aircraft plus 10 light test aircraft which would be converted into operational use—would be approximately \$350 million, encompassing the engine, component, engine, space, etc. Total of five wings would involve a total cost of about \$6.5 billion.

North American is scheduled to produce one prototype, aircraft under the present B-70 program. Including flight test, cost of this prototype program will run slightly over \$400 million. Two

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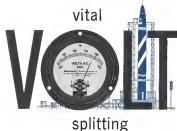
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possibly be produced for about \$440 million, says an analyst, explaining that the second aircraft could be produced for about \$60 million but a saving of about \$20 million would result in the flight test program with the second aircraft.

Already more than 9,000 lb of wind tunnel flight test have been recorded in the B-70 R&D program.

The B-70 has the capability to be in service for hours, but this extended capability would not be achievable as the aircraft would get off the ground only as fast as an interceptor, in actual time only a "matter of minutes."

Decisions were made to eliminate the use of boost fuel in the stratosphere of the B-70's General Electric J58 turbojet engines when, in addition to high cost (initially, analyses indicated that the aircraft could achieve using JP-4 alone, a 15% greater range than the goal established by SAC.

Elimination of boost fuel in the B-70 experimental engine permitted substitution of JP-4 fuels for those originally designed to carry the boost fuel. This also will simplify operational tests required by eliminating the need to finish the engine boost tank with JP-4 to work out taking which would be deposited on the inside of the tank from heat of the aircraft skin.

Integration of an environmental full scale portion of the B-70 fuselage compartment, extending from the cabin window aft to the middle of the forward fuselage, showed a width of about 64 in. of clear internal space at the floor, and a length of about 30 ft in a pressurized dome at the aft end of the compartment. Cabin head space in the cabin is about 64 in. Just forward of the pressurized dome on either side of an aisle is an inclined support for the emergency escape accommodations, both underwing and fuselage escape operator.

Channel section is about 4 in. deep and spread about 8 in. apart within the external skin. A low beam about 3 in. square is located under the top skin decking.

Construction material on the fuselage section is titanium alloy, whereas the bulk of the remaining aircraft structure is stainless steel, incorporating a large proportion of heavy-duty stainless steel.

X-15 Research Plane Reaches 80,000 Ft.

Edward AFB, Calif.—North American Aviation's No. 2 X-15 reached 80,000 ft. highest yet achieved in X-15 test program—after a drop from a Boeing B-52 at 45,000 ft. South Coastfield sent the day to March 3 in 18 min. for flight with 4 men under power.

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help. In the early hours of life, if he happens to be premature, he will need a Beckman oxygen analyzer with his hospital incubator to prevent retrolental fibroplasia—a disease that can result in blindness. ● Helping to control the air he breathes will always be a part of our job—in factories, in atom-powered submarines or in what used to be the great outdoors. He won't like smog ... and we're working on that problem too. ● His food will be fresher and tastier because a Beckman pH meter played a part in its growing and processing. The clothes he wears will look better, last longer because of Beckman instrumentation. No matter how far he goes or how high he flies, we'll be there with him ... with everything from events-per-unit-time meters for measuring engine speeds, to servomotors for his automatic pilot. ● There's scarcely a life that isn't touched by Beckman research, development, manufacture and service. We'll help baby all right. And we know how.



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Pneumatic Starter Truck Supplies Electrical Power

Truck containing a Boeing gas turbine driven compressor for providing starting air to jet engines also carries a General Electric 60 kw, 400 cps, alternate line electrical ground support. This subcomponent is located in rear and the alternator feeds the lines. The alternator is powered in the Ford truck's 352 cu. in. V-8 engine at 3,000 rpm. The unit was developed by Boeing Industrial Products Division and General Electric.

Lightplane Ice Detector

Ice formation on aircraft wings may be detected with an inexpensive optical device.

The detector consists of two translucent plastic rods placed in parallel a fraction of an inch apart on the aircraft wing. A light is beamed into one rod; a photoelectric cell monitors the other. The formation of ice causes the light which is usually trapped in the sensor rod, to reflect into the second plastic rod thus activating the photoelectric cell. The thicker the ice buildup, the more light reflected and the greater the current produced by the cell.

Aviation Research Laboratories, Illinois Institute of Technology, Chicago 16, Ill.

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Inverter, developed for the Air Materiel Command, has a voltage regulation accuracy of plus or minus 0.87% and an efficiency of 85%.

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The indicator meets MIL-A-62244 and encompasses performance meets MIL-B-6272B.

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Beech Speeds Plans for Turbine Aircraft

By Erwin J. DeBus

Heavenly Tex—Business aircraft development and marketing programs on the way at Beech Aircraft Corp., Wichita, Kan., are aimed at producing a high representation in the company's position in the fast-growing market in the next few years.

Some features of the plan have been decided by a newly formed Beech Research and Development Committee and approved by a top-level executive committee. Vice president-commercial sales Louis E. Goovers told *Business Week* here at a showing by Beech Aircraft Inc. the company's new distributor in this area.

Turbine Power

One of the decisions reached by the committee is that turbine power, particularly the turboprop, will be seen on production business aircraft replacing the light twin engine, many years earlier than had been forecast previously, and that Beech aims to move with this significant development.

"Turboprop-powered business planes are five years closer today than they were a year ago," Goovers said.

Although Goovers declined to cite more on Beech plans his observations in light of earlier forecasts by business aircraft industry observers that turboprop business planes would probably not appear in significant quantities until the 1965-1970 period—would indicate that Beech now believes that these airplanes will be available in the 1960-1961 period.

Some observers told *Business Week*.

that the chances are good that Beech will have turboprop-powered airplanes flying in at least two categories, including the light twin field, in another two or three years.

A Beech B5, fitted with Turbopropers Boston turboprops, has completed considerable test flight time in France (*AW* Dec. 5, 1955, p. 112). Turbopropers currently is fitting a French Air with Astor turboprop engines.

It is noted that Beech will be taking some big strides to meet the bold concepts of this five year plan, both technologically and in marketing. Each month, it appears that the company is developing a wide range of models to make it competitive with manufacturers in the low-to-high price categories. Although the categories from \$15,000 to \$150,000 have been mentioned, it appears more likely that these include an broad price range, rather than definite goals. Chances are that the \$15,000 airplane actually will be closer to \$3,000, but this would still represent a major success of management thinking of the areas that Beech feels benefit its customers.

Lower Price Market

Definite low-price objectives in the first entry in the lower price market Beech will penetrate. Sometime in 1961 these goals will be another airplane being, bringing Beech into the \$15,000 airplane market. This goal also will be a low-wing, metal airplane with fixed landing gear.

It appears that the committee thinking is that some basic changes in engineering and production techniques,

some feeding out of military aircraft practices, will be used to bring costs down.

One of these techniques will be simplified construction to eliminate costly rivets and joints. It appears reasonable that the company's engineers will attempt to develop some lower-cost assemblies that might be inter changeable between several models.

An example of this could be the wing of the company's four-place category, now represented by the Bonanza and Debonair and later the "515,000" airplane. These types could be considered a "family" using a basic low-wing, simplified "cut" wing.

Bonanza Growth

With introduction of other four-place models, the Bonanza could be expected to "grow" into three to four years it could go up to 400 hp, get an enlarged fuselage, new wings and tail.

Another airplane that would develop a "family" could be the Travel Air, which would develop into a turboprop version.

The Queen Air also is slated to move into turboprop and get a piston version.

Each one of these steps would probably be planned one year ahead. For example, the new business that will appear in the 1961 Travel Air will not be "better" until final decision is made on what the 1962 version of this airplane would look like.

In keeping with plans to growth, enlarges the model line, Beech expects she will achieve considerable growth. It already is working to double its cus-



Non-Roodable Aero-Plane Makes First Flight

Aero-Plane (single place, non-roodable version of the Aero), makes its first flight at Langley, Wash. The vehicle got aloft on the new 1500w engine and taking a big step toward the Aero-Plane (AW Nov. 25, p. 116). Examination of the Aero-Plane's components provided the right-wing accuracy in every line into passengers in the Aero-Plane model which costs \$8,000.

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approximately 1,100 units.

These production figures will see
Book's commercial business during the
disaster, was represented by military
business—in 1960 the company's com-
mercial business will probably run 78%
of its total, and in 1961, it will proba-
bly go ahead to represent a 40-45
ratio, with the more profitable com-
mercial business being in the lead.

Select Example

An indication of how Boeing
airplane sales are changing. Boeing's
first order, control system, covering
Houston, Dallas, San Antonio, San
Diego, San Jose, Tulsa and Glendale
City, has done much the dollar volume
of fiscal 1959 in the first four months
of current fiscal year, in deliveries and
from orders.

Exemplifying the growth that is oc-
curring in the Book sales organization
to develop this market, its new dis-
tributor, Bureau, Inc., Inc., at
Hawthorne International Airport, has ap-
proximately double the facilities oper-
ated by the former J. D. Reed organiza-
tion. Larger space is approximately
seven times greater.

Production and manager, Nick
Parker, 35, typifies the new generation
of businessmen now stepping into busi-
ness aircraft distribution. He formerly

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available HMA or heat units are a popular choice for more efficient
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as HMA, design, construction (including shop drawings) and installation
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Circuit Design Engineers... who experience in design of high speed switching circuits, pulse techniques, and computer logic. Should be experienced in one or

more of the following areas: microprocessors, analogs, control systems, CUM, PM, PCM, PDM, and logic circuitry.

Packaging Engineers... with a broad, solid edge of packaging and production techniques in about metal and electronic equipment. Will design electronic portions of guided missiles, rockets, computers, test equipment. Should have thorough knowledge of assembly.

Electronics-based Designers... will design electromechanical equipment and electronic portions of guided missiles, including modification of others through the shop. Will work closely with Design Engineers in developing electronic packaging philosophies. Knowledge of electronics, electronics components, and ability to read schematics required. Should have experience in sheet metal equipment design and knowledge of current "state of the art" in electronic equipment.

Call collect Chestview 4-8884 and ask for Mr. Jerry Morris. He will arrange an appointment for you with key personnel at the Redford Laboratory. If you prefer, send your resume or letter to Mr. Morris, Raytheon Company, Missile Systems Division, Bedford, Mass.



MISSILE
SYSTEMS
DIVISION

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operated auto bodies and printing facilities in Boston. Petric became aware of the security potential through conversations with his customers who were highly business executives. He noticed that more and more of these executives developed companies, explains that had purchased and decided that this was a growing enterprise that he might get into.

A former World War II U.S. Marine fighter and bomber pilot in the South Pacific and commander of a Corsair squadron on the West Coast during the Korean War, Petric will put his full time into his new operation, beginning his former interests.

In contrast to his former responsibility \$100,000-a-year's Beach Electronics can take from \$100,000 to \$400,000 and up to 51 million to start-but Petric has his eyes set on a volume of approximately \$2 million gross this year and the future, that he is one of the top six remote producers in the country. Beach Aircraft includes:

Business Aircraft: seven Hawker, Citation, Beech, Port Arthur, Lufkin, Bonanza and Cessna, plus 41 surrounding counties in Texas and Louisiana.

Aeroflot Develops Air-Drop Containers

Moscow-Russia's Aeroflot has developed a wide variety of air-drops that can be used for dropping loads weighing up to 7,000 lb. without using parachutes.

Need for such packages is greatest in sparsely-populated areas of the Far North's tundra, tundra where aircraft landings are difficult or impossible and where emergency loads dropped in parachute frequently are carried away from the target area in strong winds.

Latest type of air-drop package to be used successfully is a small, wrapped-paper sphere which reportedly can be made from any printing plant's waste paper at a cost of 1 to 10 rubles (10 rubles is a dollar at the present rate of exchange). The sphere can be torn apart in folded form "like a fan" but when expanded its inside consists of many paper hexagons with space in the center for a load weighing from 2.5 to 6 lb.

Aeroflot's largest air-drop containers are of the "pennant-shaped" type. This consists of three or four folded strips laid together, sealed with sewing. Adhesive or explosive fastener tubes are also used.

Open ends of this "package" are closed with inflated water or salt-filled bladders. Aeroflot says this type of container can be assembled at an airport or several airports and can be used for up to 100 air drops. Water bladders can



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BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 8150/TE-70 Klystron tube combines ruggedized construction and thermal tuning. The construction provides a drainable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency range of less than 1.3 MC at 50 cps. Thermal tuning provides a dual advantage. It permits tuning the tube over its entire operating frequency range without mechanical means-and the tube can be

repeatedly cycled throughout its tuning range without damage or deterioration.

These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For background information and brochures, write Red Bank Division, Bendix Aviation Corporation, Dayton, Ohio 45424.



The 8150/TE-70 (center) is the only klystron available in the 8150/TE-70 series of a tube size that meets the 1.3 MC frequency range.

The 8150/TE-70 is the only klystron available in the 8150/TE-70 series of a tube size that meets the 1.3 MC frequency range.

The 8150/TE-70 is the only klystron available in the 8150/TE-70 series of a tube size that meets the 1.3 MC frequency range.

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doppler principle, and the brighter the future of all who work with the leader in this field.

There are tremendous openings with Ryan in two of Southern California's most progressive communities. San Diego and Torrance, noted for ideal climate, fine housing and outstanding educational facilities. If you've even considered making a change, for full particulars, send your resume or write for a brochure to Ryan Electronics, Department 4, 8650 Kearney Mesa Road, San Diego 11, California.



RYAN ELECTRONICS

DIVISION OF RYAN AERONAUTICAL COMPANY, TORRANCE, CALIFORNIA SAN DIEGO, CALIFORNIA



Helicopter Taxi Service Operates in Los Angeles

Non-scheduled helicopter taxi service is being operated between downtown Los Angeles and Los Angeles International Airport by Helicopters, Inc., a charter operator. Helicopters are two Bell 47J models leased from National Helicopter Service, a charter operator. The 47J are flown by National pilots. Additional helicopters will be made available from National's fleet to meet Helicopters' requirements. This service, flown only during daylight hours, costs \$11 a person one way between the Pacific Century Building heliport (VAFB-21, p. 34) and the airport. The top takes 9 min. A downtown Helicopters rate will be operating at Pasadena within 90 days.

closed in such packages have been dropped in ice from a height of 3,500 ft without breaking.

Most rugged type of air drop package used by the Russians, which is a sponge, rubber sphere, with space inside for explosives, medicines or livestock vaccines. Containers such as this have been tested as many as 500 times.

PRIVATE LINES

December deliveries of U. S. Sparrows and satellites totaled 734 units with manufacturers' net billing total value of \$12,290,000, compared with 585 units shipped in December, 1977 with a value of \$9,726,000. Total 1978 deliveries were 7,699 units with a total value of approximately \$270 million, compared with 6,454 aircraft having a total value of about \$175 million a year ago. Factors shipments in 1979 996 two engine Hercules planes.

Production of Sikorsky two-place private plane is expected to reach 10 per day by the end of 1978's first quarter. Sikorsky Aircraft Co., 371 Goddard Circle, will introduce one, under the Spring

First Coast dealer show in the New York area was held a success after the dealer, Teledrome Aircraft Services, Inc., Fairfield, N. J., wrote orders for two Model 5500s, a Model 210 and a

Skyline during the weekend event.

High altitude charts (book shown H-060 H) for general aviation pilots are now available from Jeppesen & Co., Denver, Colo.

Deere & Co., Moline, Ill., has purchased a Douglas DC-3 modified for passenger loading and unloading after work by Research Services, Inc., St. Louis. Plane has been cleared accordingly to provide a 200 mph cruise speed. Tom Rucke is Deere's chief pilot.

Long-playing record extended. On Course. On the Club with a new contractual ad for private pilot's interest in aviation magazines. The record priced at \$3.95, is being offered by General Aviation, Inc., Scottsdale.

General Aviation Engineering Corp.'s Ag Cat has been authorized by Federal Aviation Agency for a 500 hp. McCormick in a 420 hp. Pratt & Whitney engine. This amphibious airplane is currently powered by a 220 hp. Continental engine. The Ag Cat (AW May 12, 1978, p. 111) was sold in 1979. The Ag Cat is a four-seater, is 115,000, construction expenditure needed costs \$18,800.

PROBLEMATICAL RECREATIONS 2

"To stimulate his use in the period of partial differential equations, a much professor offered to pay him \$5 for every equation correctly solved and to him \$5 for every equation solved. At the end of 26 problems, neither owed any money to the other. How many did the boy solve correctly?"

—Adapted from Checco, 1987



Our custom-based digital data system is the smallest, most complete, most powerful digital system of its type. Engineers, interested in seeing actual designs for digital and analog computers and associated input-output devices for these systems are invited to write Mr. Ross McViney.

ANSWER TO LAST WEEK'S PROBLEM: The conditions of the problem present a second degree difference equation in two variables which can be factored. With the three sets of two solutions, taking into account the given conditions, viz., number of articles purchased equal to the average cost and the inequality of 63 papers were spent by each head-head this fact one can associate each couple. Hence the answer is $A=C_1, B=B_1$ and $C=C_1$.



LITTON INDUSTRIES
Electronic Equipment Div.
Fremont Hills, California



HILLER 12E performance and capabilities are increased with lift for installation of demonstrator, dual conversion, high compression piston and turbo-supercharged engine. Hiller 12E is shown lifting a helicopter to a demonstrator at Casaca, Venezuela.

Kits Extend Hiller 12E Capability

Folsom, Calif.—Hovers at 20,000 ft. at maximum gross weight will be possible in the Hiller UH-12E with installation of a turbo-supercharger kit. Other modifications, also available as kit items, are designed for payload and performance increases as part of the planned growth potential built into the helicopter according to Hiller Aircraft Corp.

Increasing engine output from three to four is possible by installation of a three-cylinder kit.

Weight Increase

Gross weight increase caused by the modification is 55 lb. No modification is required to the power or drive system. However, a slight increase in performance results—hover out at ground effect (HOGGE) increases from 1,640 ft. to 1,690 ft. and hover in ground effect (HIGGE) decreases from 3,940 ft. to 3,490 ft. Sea level climb drops from 44,000 ft. to 11,600 ft.

Performance loss due to the added weight of the modification can be offset by increasing horsepower through the addition of:

- **Dual conversion:** Adding 15 hp while increasing gross weight by 70 lb. dual conversion will boost HOGGE altitude

- by 1,170 ft. HIGGE will increase by 1,160 ft. and service ceiling increase 1,600 ft.
- **High compression pistons:** Replacing 100/110 inches inch, rather than 93/97; as used, the new pistons add 2 lb. to the gross weight while increasing HOGGE to 1,690 ft. HIGGE to 1,190 ft. and service ceiling to 2,000 ft.
- **Combustion of dual conversion:** and high compression pistons. Result is an increase of 2,500 ft. in HOGGE as

crease of 2,500 ft. and service ceiling boost of 2,900 ft.

- **Turbo-supercharged:** Licensing VDA-140 engine. Hiller says that this new engine, certification of which is expected soon, will develop 100 hp. go at least 18,000 ft. Then, HOGGE, HIGGE and service ceiling all will be the same—33,500 ft.

Performance of a basic Hiller UH-12E at 2,750 ft. gross weight is HOGGE 1,590 ft. HIGGE 3,490 ft., service ceiling 14,000 ft. Maximum speed vertical and forward rates of climb are unaffected by the modifications.

47Js Fly Schedules in St. Louis

Scheduled helicopter service, connecting St. Louis Municipal Airport with downtown and downtown airports begins this month with Bell 47J Ranger.

Missouri Valley Helicopters, Inc. will operate 40 flights a day, Monday through Friday, using two 47Js on each trip. All seats are reserved.

The company will operate a courier service from the 18th St. heliport in downtown St. Louis to eight local and semi-remote district points.

Single passenger flights between the airport and Forest Park, suburbs between downtown and the airport is 54. One between downtown St. Louis and the

airport is 57. Courier air service is scheduled by the firm.

The trip from the airport to Forest Park takes 5 min., from the airport to downtown, elapsed time is 9 min.

The first flight in the day leaves the airport at 9 a. m. The last flight departs downtown at 9:45 p. m., arriving at the airport at 9:50.

Missouri Valley Helicopters was established a year ago and began charter service (AVN, Nov. 16, p. 91) with six helicopters. In its first year of operation it flew more than 6,000 passengers a total of 100,000 mi. It now operates four helicopters.

WHO'S WHERE

(Continued from page 21)

Changes

J. F. McNeeney, manager of the newly formed Liquid Propellant Operations of Rockwell's a division of North American Aviation Inc., Chicago 240, Calif. E. A. Wright succeeds Mr. McNeeney as manager of the North American plant near Los Angeles, Calif., space plant manager.

James W. Herlihy, general manager of the Downey, Calif. plant of Lockheed Corp., Downey, Calif.

Joseph J. Dwyer, manager of commercial programs, Douglas Aircraft Co. Inc., Santa Monica, Calif.

Mr. Charlotte Franklin, international public relations director, Yang Industries Inc., Los Angeles.

Dr. W. Wu Chao, chief of research, Victor Inc., division of Sperry Rand Corp., Detroit, Mich.

Raymond T. Smith, manager of sales and production and systems development at the Lockheed Corp., Long Island City, N. Y.

George K. Fritzsche, general manager, General Electric Co.'s Defense Department Products, New York.

Ronald H. Farwell, senior research engineer responsible for study of the motion and control of space vehicles, has joined Kennedy Associates of Princeton, N. J.

John W. Masch, flight operations manager for General Corp., Los Angeles, Calif.

Mr. F. H. Hinkley, head of Adhesive Research Corp.'s Adhesive Division, Chicago, Ill. Other research units in the new group: David Brown, senior engineer, John W. Masch, Jr., executive, and general manager, Masch, Hinkley, responsible for adhesive research.

Gilbert H. Lee, converted director, Southwestern American Corp.

Dr. Donald F. Mitchell has been appointed a board member, member of the North American and Research Laboratories of Northrop Corp.'s North American Division, Calif.

Reg. Gen. David E. Van Sledright (AFM) is director of the newly established Office of Foreign Operations, Armed Forces Corp., New York.

David K. Kohn, manufacturing manager, Helicopter Division of American International Inc., Palmdale, Calif.

James F. Lafferty, director of the West Corp.'s Lafayette, D. C. office.

Dr. Robert W. Bess, chief scientist, has been director of Science Mission Institute Corp., Redwood, Md.

James Applbaum, Jr., South, Wash. has assumed the duties of chief operations on the Division's last job, which project William E. Rindler, manager, program manager, Boeing Military (M-1) system manager, Ford Systems, customer support manager, Elva Lewis, system growth manager, Robert F. Wells, program planning and control manager.

Stephen K. Campbell, director of engineering, Scientific Division of Hughes Aircraft Corp., Culver City, N. Y.

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